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WITH MR. MAYO ROBSON

Diseases of the Stomach. Second Edition. 1905
Diseases of the Pancreas. W. B. Saunders & Co. 1902

ABDOMINAL OPERATIONS

BY

B. G. A. MOYNIHAN, M.S. (London), F.R.C.S.

LEEDS

Second Edition, Thoroughly Revised

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TO MY WIFE

PREFACE TO THE SECOND EDITION

ALTHOUGH only a very few months have passed since the publication of the first edition of this work I have found it necessary to make a large number of additions to the text and to the illustrations; some revision has been desirable; and two of the chapters have been entirely rewritten.

The reception the book has met with has exceeded my most hopeful anticipations. I have interpreted it to mean that a work of this kind was needed, and it has compelled me to put forth my utmost endeavour to render the book of service to those engaged in the practice of surgery.

I desire especially to acknowledge the help which I have derived from the work of three surgeons whose contributions to the literature of abdominal surgery are of the very highest importance. I refer to Dr. W. J. Mayo, Dr. J. B. Murphy, and to my former colleague, Mr. Mayo Robson. The mention of their names in the following pages, frequent though it be, is inadequate to express the manifold advantages I have derived from a study of their work or from the privilege of watching their practice.

The new illustrations have been drawn for me by Miss Ethel M. Wright. I am indebted to Mr. Rupert Bucknall for four illustrations and to Dr. Campbell Thomson for one.

B. G. A. MOYNIHAN

August 15, 1906

PREFACE

In this volume I have included only those operations which are common to the two sexes. No gynæcological operations are described.

The surgery of organs, such as the kidney and the bladder, which is partly intraperitoneal and partly extraperitoneal, is not included, nor are the various operations for hernia.

The operations described are those in general use, and all, or almost all, of them are those practised by myself. Some comment will doubtless be made on the fact that there is no detailed reference to any mechanical appliance, button or bobbin, for intestinal anastomosis. This omission is made deliberately, for I believe that the purpose of these mechanical aids has been served, and that their interest is now only historical.

The illustrations are, with few exceptions, original, and have been drawn for me by Miss Ethel M. Wright. I desire to express my thanks to her for her careful and successful work. In preparing the subjects for illustrations, and in the laborious task of reading proofs, I have received great help from Mr. W. Gough, F.R.C.S., and Mr. H. Upcott, F.R.C.S.

I am greatly indebted to my secretary, Miss A. M. Harrold, for help at all stages of the work.

B. G. A. Moynihan

33 Park Square, Leeds

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ABDOMINAL OPERATIONS.

SECTION I.

GENERAL CONSIDERATIONS.

CHAPTER I.

THE BACTERIOLOGY OF THE STOMACH AND INTESTINES.

MANY of the problems connected with the surgery of the stomach and intestines depend for their elucidation upon a knowledge of the bacteriology of the alimentary canal. This subject is one in sore need of further investigation.

Billroth in 1874 was the first to recognise that the intestinal contents of the newborn are always sterile, and that the yellow stools, coming a few hours or days after birth, are the first intestinal discharges to contain micro-organisms. Popoff and others shewed that the appearance of the bacteria in the motions depended upon the time at which the first nourishment was taken. The exact origin of the *Bacillus coli*, which is the constant inhabitant of the intestinal canal in man, has never been satisfactorily determined; but there can be little doubt that the infection takes place through the mouth, and that the vehicle is the food. It is to Escherich that we owe a recognition of the fact that the *Bacillus coli* is the characteristic organism of the human intestine, and that it remains an unvarying inhabitant throughout life.

A bacterial invasion of the intestinal canal is not essential to the life or health of the individual. Experimental work,

which has been amply confirmed, has shewn that life may be sustained in young animals whose food and whose surroundings are sterile. Nuttall and Thierfelder obtained a guinea-pig from its mother by Cæsarean section, and placed it at once in a sterile chamber, supplied with sterile air, and fed it upon sterilized foods. At the end of eight days the animal, which was thriving, was killed, and its intestinal contents found to be sterile. Levin investigated the bacterial conditions in the intestinal canals of animals, bears, seals, reindeer, etc., in Spitzbergen, and found that, as a rule, the contents of the bowel were sterile. In the arctic regions, of course, there is a great scarcity of organisms both in the air and in water.

Within the first few hours of life the intestinal contents cease to be sterile; organisms can always be found. Of these organisms, two varieties are described the permanent and the transient. The permanent variety in man is the *Bacillus coli;* the transient includes any that are introduced into the intestinal canal by the food. It is obvious that, if any organism whatever be introduced deliberately into the stomach with the food, it will remain for a shorter or longer time an inhabitant of the alimentary canal. But, as Gillespie and Miller have shewn, when bacteria are introduced in this way there is a steady decrease in their numbers as digestion proceeds, and in proportion to the increase in the acidity of the gastric contents. According to Miller, at the end of nine hours the stomach contains no organisms. In the duodenum the number of the bacteria is small; but, the further down in the intestine is the material from which the examination is made, the more numerous are the organisms, until the ileocæcal valve is reached. In the large intestine the bacteria are again few in number. Gilbert and Domenici have represented diagrammatically the average bacterial virulence of the alimentary canal of dogs.

Harvey Cushing has investigated the conditions in cases of intestinal fistula. In a case of jejunal fistula a glass of milk

could be entirely recovered within a few minutes of its ingestion, with its bacteriological features practically unchanged. The importance of the physical characters of the food is therefore considerable. If the ingesta be fluid, they are passed rapidly onwards into the duodenum, and are but little, if at all, altered by transit through the stomach. If the food be solid, it will remain, perhaps for hours, in the stomach, subject throughout this time to the action of the gastric juice, and when passed into the duodenum it will have the number

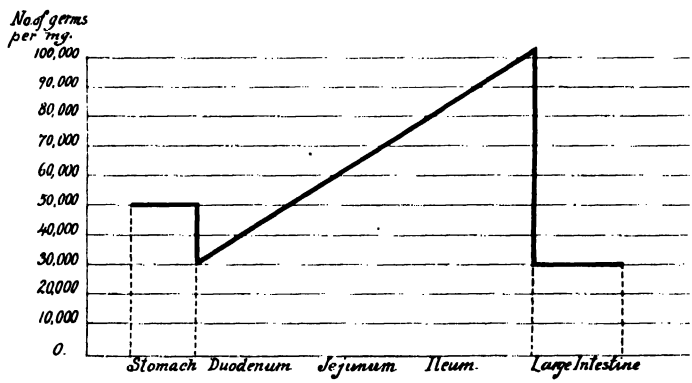


Fig. 1. —"Gilbert and Domenici's diagram shewing the relative number of bacteria present in the contents of different parts of the alimentary tract. The dogs were killed three hours after a meal of bread and meat. Examination of the intestinal contents at this stage of digestion shewed an abundance of organisms in the stomach, a pronounced diminution in number at the duodenum, followed by a gradual rise to the ileocæcal valve, where bacteria flourish in the greatest luxuriance. When the large intestine is reached there is a marked falling off in the number, with a slight rise proportionate to the distance from the cæcum" (Harvey Cushing).

of its bacteria greatly reduced. Macfadyen, quoted by Cushing, has shewn that the bacillus of anthrax, an organism easily killed by the gastric juice, cannot be recovered from the intestine when taken after a full meal, but that when administered with a large amount of liquid on an empty stomach, its recovery from the lower bowel is easy. In one of Cushing's cases, the *Bacillus prodigiosus*, an organism especially susceptible to the action of the gastric juice, could be easily recovered from a jejunal fistula after its ingestion with inoculated milk.

When the stomach has emptied itself of food, either fluid or solid, the mucous membrane is sterile; the small amount of material that can be scraped from the mucous surface contains no organisms. Marfan and Bernard have shewn that the same applied to the intestine: that when any part of the intestine has emptied itself of its contents, it becomes amicrobic. In cases of artificial anus in man, the distal loop of the bowel, so long as it remains empty, is always found to be sterile. If from any reason the stomach is unable to empty itself satisfactorily, leaving always some food stagnant, the natural amicrobism can never be attained. Cushing writes: "It is, I believe, dependent only upon interference with the

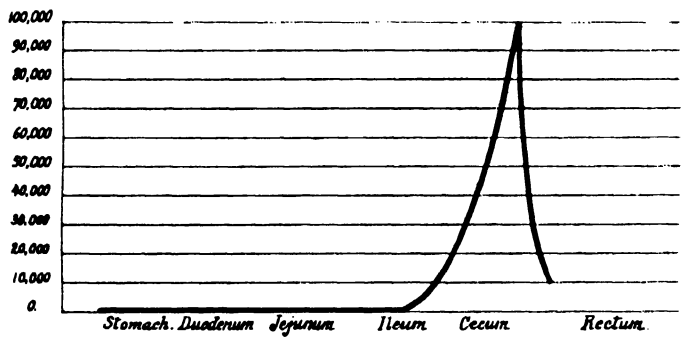


Fig. 2.—Harvey Cushing's diagram shewing the relative number of micro-organisms at different levels of a dog's intestine after a prolonged fast.

stomach's power completely to expel its contents that bacterial life may persist in its lumen. The same principle holds true for the duodenum, and it is not improbable that a similar amicrobic state following digestion, with a canal completely free from food and the accompanying bacteria, may be brought about as far down as a condition of emptiness may be reached through fasting." In a dog that had been starved for several days, the upper part of the intestine was found sterile. The accompanying diagram which Cushing gives may be contrasted with that given by Gilbert. It will be seen that all that portion of the intestine which can be rendered empty is by this

means alone rendered sterile also. Conversely in cases of acute or of chronic intestinal obstruction where the bowel has been unable to empty itself for days or for weeks, the intestinal contents are teeming with bacterial life; the *Bacillus coli* and streptococci are often found in great numbers, and their virulence is extreme.

The conclusions which may be stated are as follows:

1. The stomach contains, immediately after a meal, a number of micro-organisms of different varieties, according to the nature of the food administered.
2. If the food is given in a liquid form, it is rapidly passed onwards into the intestine, and the bacterial forms are but slightly, if at all, affected.
3. If food is given in a solid form, it remains longer in the stomach, and the number of bacteria contained therein undergoes a steady diminution until digestion is complete. The empty stomach is then amicrobic.
4. The duodenum is often sterile; the number and virulence of the bacteria of the intestine increase in proportion to the distance from the duodenum, and attain their maximum at the ileocæcal valve.
5. The *Bacillus coli communis* is the characteristic organism of the human intestine; it is never absent after the first few days of life.
6. The stomach and the upper part of the jejunum can be rendered sterile by administering only sterilized foods and by attention to the toilet of the mouth. In dogs, starvation for a few days leaves the upper part of the intestine empty and sterile.
7. The stomach and intestine, when their contents have been discharged and they are empty, are sterile. If the emptying is prevented by obstruction at the pylorus, or in the intestine, the contents, dammed up behind the block, contain organisms whose number and whose virulence are greatly increased.

The importance of these facts from the surgical point of view is that they shew what is to be expected in cases of perforation of the stomach or intestine, and they demonstrate the possibility of rendering sterile, for purposes of operation, the stomach and the upper part of the intestinal canal. For example, when peritonitis results from a perforation high in the intestine, the offending micro-organism is generally a streptococcus; when the perforation is low down in the intestine, the *Bacillus coli* is the most abundant or the only organism.

It is to Dr. Harvey Cushing, of Baltimore, that we are indebted for calling the attention of surgeons to the possibility of rendering the stomach and intestine sterile as a preparatory measure to operations. He wrote, in a very able paper from which I have quoted freely (vol. ix, "Johns Hopkins Hospital Reports"):

"The procedure which we have employed is simple and mainly consists in an attempt to render amicrobic all ingesta. The mouth is rinsed with an antiseptic solution and the teeth are carefully brushed at intervals of a few hours, and with especial care before and after feeding. The stomach, if any chronic catarrh exists and micro-organisms in number are found present after a test-meal, is washed out carefully morning and evening. Food is taken in small amounts and at comparatively frequent intervals, from clean or, preferably, sterile vessels, and consists of boiled water, sterilized milk, beef-tea, albumin-water, and similar liquids. Patients with chronic gastritis have been seen to gain in weight under this régime. Preliminary to the operation for from six to ten hours nothing is given by the mouth, rectal feeding being instituted if necessary."

Many drugs have been given in the hope that by their aid the intestinal contents could be rendered sterile. Among such are β-naphthol, salol, iodoform and actol, to mention only a few. All have proved useless. Recently Adolph Hofmann ("Mitth. a. d. Grenzgebiet.," 1906, Bd. 15, Heft 5, p. 596) has recorded a series of observations made upon the intestinal contents

(recovered from fistulæ, colotomy openings, and enterostomy openings) after the administration of isoform. This drug is administered in powder or in capsules, or in both together, the dose being 3 grammes, given in quantities of ½ gramme, within a period of two to twenty-four hours. The effect was remarkable and constant. The number of colonies that could be cultivated from the discharge was enormously reduced in all cases. The rapidity with which the effect upon the contents was produced depended upon the part of the alimentary canal from which cultures were taken. In cases of pyloric disease the effect upon the stomach contents was noticed in a few minutes, if the drug was administered in powder. Isoform is supplied in powder and in capsules, hardened and unhardened,—the latter dissolve in about an hour and a half in the stomach, setting free the drug; the former pass into the intestine where they are dissolved in a variable and often uncertain time. In the intestine an undoubted effect is produced in thirty hours from the administration of the dose. Though 3 grammes is the usual dose, as much as 7 to 8 grammes have been given to the adult male without producing distress. The symptoms which come from an excessive dose, or from too frequently repeated doses, are loss of appetite, vomiting and a feeling of sickness.

CHAPTER II.

GENERAL REMARKS UPON THE PREPARATIONS NECESSARY IN ABDOMINAL OPERATIONS, UPON THE CONDUCT OF THE OPERATION, AND UPON THE AFTER-TREATMENT OF THE PATIENT.

Success in abdominal surgery, as in all the affairs of life, depends very largely upon the observance of details. In the careful examination of the patient, with reference both to the local and general conditions; in the strict preparation, for a few days before the operation, whenever possible; in neatness, rapidity, and thoughtful planning of the operation –in all these there lie the means and the secret of success. With few exceptions, the same technique is desirable in all operations. I propose to describe the details which are carried out in my own operations, first, with reference to the surgeon, assistants, nurses, instruments, and dressings; and, secondly, with reference to the patient.

PREPARATIONS ADOPTED BY THE SURGEONS AND ASSISTANTS.

It is most desirable—it is even more, it is absolutely necessary —that for the due observance of cleanliness during operations the surgeon should be properly clad. The garments which are suitable for daily wear are surgically unclean and should be changed by all those who are to be in immediate proximity to the area of operation. In former days the surgeon felt that he was adequately prepared for an operation when he had perfunctorily turned back the cuff of his coat, and in the illustrations of all the older works on surgery (borrowed and reproduced, it is sad to say, even up to the present) the surgeon's cuffs and links are neatly depicted. The removal of the coat and the wearing of a special

coat—generally an old-fashioned and almost worn-out overcoat—was considered a striking improvement. Such a garment was worn from day to day, and becoming more and more stiffened by freshly added splashes of blood, was as disreputable and as greatly prized as the dilapidated gown of an under-



Fig. 3.—The surgeon prepared for operation wearing the spectacle mask.

graduate. I can still recall the thrill of excitement and the murmur of amusement that greeted the appearance of the first white operation coat in my own hospital. To-day, however, the surgeon should be clad from head to foot in spotless sterilised garments. A sterilised cap is worn, so that the heads of the surgeon and his assistant when they meet in sharp contact

over the abdominal wound shall not scatter hair and dirt broadcast. A sterile coat is worn, sterile sleeves, and boiled rubber gloves. Sterilised or, at least, newly washed, white trousers and clean shoes, preferably with rubber soles, are worn. Prepared in this way, the surgeon is safe not to inflict a chance infection in any wound. All parts likely to be near the wound or to touch it are absolutely clean.

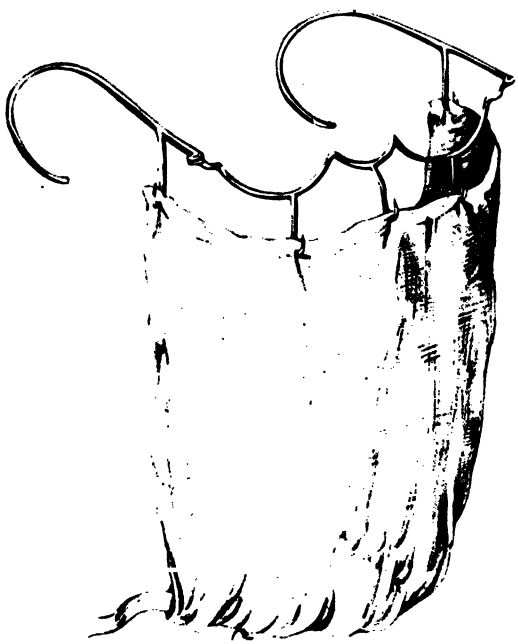


Fig. 4.—Gauze mask. The gauze is suspended on hooks dependent from a spectacle frame.

It is not enough, though one can see the practice every day, to wash the hands and perhaps the forearms and to be content with this. When instruments are lying on a towel during the performance of an operation, the surgeon may, in some manipulation, allow an unclean elbow or arm to rest for a few moments upon an instrument, and presently employ that instrument again. The operator should be so prepared

that all his accessible surfaces are clothed with sterile garments. Exactly the same rules apply to the assistants and the nurses. There should be no uncovered surfaces, which, by contact, are likely to cause infection. Experimental work, amply confirmed, has shewn that particles of saliva are ejected during ordinary conversation to a considerable distance. The saliva contains organisms in profusion. According to one eminent bacteriologist it is in this respect "worse than the worst London sewage." Unless the operator and his assistant, and all those nearly engaged in the operation, can preserve absolute silence during an operation, they should wear gauze masks. I have had a sort of spectacle frame made for me to which the gauze is fixed. The frame is fixed, by bent sides, behind the ears, so that there is no fear of the gauze slipping or becoming displaced during an operation. It is the custom among the unenlightened to scoff at the necessary precautions taken by those who practise aseptic surgery; the meaning of the word "aseptic" is forgotten. The thoughtful enthusiast may console himself with the reflection that in every race there must be some who lag behind. The laggards, moreover, are generally those who are "quite satisfied with their results;" a testimony not, as it is intended to be, to their results, but rather to the ease of their satisfation.

Hands.—The preparation of the hands should be the same whether gloves are worn or not. It is almost impossible to over-emphasise the importance of thorough cleansing of the hands and nails. The literature on this one subject alone would require almost a lifetime for the reading, but the conclusions of all investigators are unanimous in stating that an assured and absolute sterilisation of the hands is impossible to obtain. But there can be no question that a sufficiently near approach to perfection can be attained by the exercise of the greatest care. Professor Kocher, for example, whose results are at the least the equal of any, operates with bare hands. But of the care taken by him to ensure cleanliness, all those who

have seen him work, or who have read his book, will realise. It could, I think, be successfully argued that of all the details in the preparation for an operation none equals that of the cleansing of the surgeon's hands.

The preparation begins with a thorough washing in soap and hot water. When the hands and arms are socially clean, a nail-brush or, what is perhaps better, some squares of sterile gauze or butter-muslin, may be taken and a thorough scrubbing of the hands, fingers, and nails especially, is begun. Each finger and each nail must be separately scrubbed, and frequent rinsing, in water as hot as can be borne, is necessary. If possible, running water should be used, but, failing that, a series of basins will do equally well. After prolonged washing in one basin, a second is used, and a third, and finally a fourth. Each basin and the water which it contains should be sterilised. It is of no advantage to have sterile running water if the basin into which it runs is a fixed basin, which cannot be rendered sterile; nor is it possible to have water remain sterile if the basin which it fills is fixed, as in the ordinary lavatory. Either the water must be running continuously and allowed to flow over and away from the hands and arms, or the basin and its contained water must each be easily sterilisable. The washing must be carried out regardless of time. After at least fifteen minutes of soap and water, the hands and nails may be scrubbed with sterile gauze, which is worked into all the crevices and cracks which exist on every hand and finger. After this, some antiseptic application is necessary. The best is alcohol in some form or another. A solution of 60 to 70 per cent. of alcohol to the extent of two or four ounces may be poured over the hands, rubbed well over, and wiped off with a sterile towel, or the hands may be soaked for a few minutes in a solution of spirit and biniodide of mercury. Instead of alcohol a watery solution of biniodide of mercury 1 : 2000 with potassium iodide may be used, and the hands, forearms, and elbows allowed to soak therein for at least five

minutes by the clock. The great disadvantage of all antiseptic preparations for the hands is the undoubted tendency that they have to cause roughness. This rough and coarse condition of the skin makes any cleansing very much more tedious and any reasonable sterilisation very difficult of attainment. In these matters the personal idiosyncrasy of the surgeon counts for much. Some operators can bear mercury compounds, others are immune to the irritation of carbolic, but all, so far as I can judge, can bear to use alcohol preparations better than any other antiseptic agent. My own practice is to wash thoroughly in the way I have described, with soap and hot water, to use gauze friction, to steep for a few minutes in 1 : 2000 biniodide, then to have a wash over with 65 per cent. alcohol, and finally to rinse well in sterile salt solution.

Gloves.—It is now my invariable practice to use rubber gloves during operations. At the first I found some difficulty in working in them, and I felt clumsy and inapt. That was the fault of the gloves, and of my want of knowledge of the proper method of putting them on.

I now use No. 7 or 7½ light or medium rubber gloves. They are a size smaller than my ordinary glove, and therefore fit fairly tight. After being boiled for twenty minutes they are put on in the following way: The opening in the glove is held stretched wide by two fingers and the glove is filled, by a movement of "scooping," with sterile salt solution which fills the basin in which the gloves lie. When the glove is nearly filled with water it is held in one hand while the other hand gently wriggles into it. As the hand enters, water escapes until the fingers have reached to within about an inch of the tip. The cuff of the glove is turned backwards and the glove is held from the inside. It is only after the sterile sleeves have been put on that the cuff is turned over on to the forearm. Then the other glove is filled and put on in exactly the same way. The further pulling on of the gloves is impossible, but they may be made to go on by rapidly stroking the glove from the

fingers to the wrist with dry sterile gauze. The glove when fully on should fit quite tight, but should not be so tight as to hamper the movements of the hand. The outside of the glove should never be touched with the opposite hand, which, though scrupulously prepared, should be considered, as it doubtless is, capable of infecting the glove if friction be used. (See Kocher's "Operative Surgery," second English edition.)

During an operation the glove-covered hand is rinsed in sterile salt solution as soon as soiled. As a rule, it is easier to work with a glove which is wet than with one which is dry, for when dry, the gloves are apt to stick to instruments, ligatures, and swabs. A frequent rinsing in a sterilised solution is therefore necessary. No antiseptic solution is ever used, and none is permitted to touch the peritoneum. There is abundant experimental evidence to shew that the delicate peritoneum is seriously damaged by contact with antiseptic solutions, and that its power of absorption is thereby decidedly lessened.

During an operation a glove may be pricked or torn by a needle or other sharp instrument. This is more likely to happen when the operator is unused to gloves; as he becomes more accustomed to them and has cultivated a slightly altered tactile sense, he will find that an injury to a glove is rarely caused. If the prick be on a finger, a finger-stall or a finger cut from another glove which has been partially spoilt, must be used to cover the damage. This should be done at once, for if the glove has been worn even for a few minutes, the hand will be septic. The sweat-glands and the deeper portions of the skin will have emptied their organisms on to the surface of the hand. If a rent be made in the hand of the glove, a fresh glove must be put on at once. It is, therefore, always necessary to have a reserve pair of gloves, for the surgeon and for his assistant, and several glove-fingers.

At the first using of the gloves the operator will doubtless feel that the fingers are clumsy, and that it is difficult to get

a proper grip of any structure. A little practice, however, will soon overcome all these initial difficulties. If a flat gauze swab be used on the gloved hand, it will be found that a better hold is thereby obtained than is possible with the bare hand. A pattern of glove has recently been sold in which the surface of the rubber is roughened by the impress of innumerable fine pits. In use, however, I have not found any advantage from this.

After the surgeon has become thoroughly accustomed to the wearing of the gloves, he will probably find that he can work quite as well with medium as with thin gloves.

Assistants.—The remarks made as to the preparation of the surgeon apply also to his assistant. As a rule, only one assistant is necessary or desirable. Indeed, many operations—such, for example, as gastro-enterostomy—can be done without any assistance. A good, well-trained assistant is, however, a great help. More assistants than one are rarely, if ever, necessary, and each one is an additional potential source of infection. The fewer persons engaged in an operation, the fewer are the chances of infection. The nurse or nurses immediately engaged in the operation are instructed to prepare in the same manner as the surgeon. A white, sterilised dress or overall is worn, the hair is covered with a sterile cap, and clean, white rubber shoes are worn. If a nurse helps in the operation by handing swabs or sponges, or by cutting ligatures, threading needles, or the like, she should prepare her hands as does the surgeon, and should wear rubber gloves. In these circumstances, she becomes an additional assistant, and if the same nurse be employed over a series of months or years, she will soon become expert in her work and scrupulous in the preparation for it.

Swabs.—Swabs are employed for all operations. I have ceased to use marine sponges for several years; they are more difficult and more tedious to prepare and are not so trustworthy. The large, flat sponge certainly answered its purpose—

the protection and covering of the viscera—rather better than any flat swab I have used, but the difference is only slight and is more than compensated, for in my opinion, by the greater sense of security that one has in regard to the sterility of a gauze swab.

Swabs are made entirely of gauze or butter-muslin. I prefer the latter. The swabs are of various sizes from three inches square to six inches square, and are made by folding over, two or three times, a large square of gauze. The frayed ends of the gauze are tucked in, so that no loose filaments are left on the wound when the swab is used.

The large flat swabs are made of several layers of muslin, and are quilted at the edge in order to prevent fraying. At the corner of each, a piece of tape eighteen inches in length is stitched. The whole of the gauze square can be introduced and the tape left hanging from the wound, a clip being fastened on the end. This method is the most satisfactory of all, for, if no tape be affixed, the sponge or swab must be kept in sight, or a portion of it must project from the wound, and the space in which the surgeon has to work is thereby greatly narrowed.

The small swabs are put up, for sterilising purposes, in packages of two dozen, the large ones in packages of half a dozen. The number of each size is counted at the completion of the operation so as to make certain that none has been left in the abdomen. My own rule is never, under any circumstances, or in any operation, to allow a small swab to be left even for a moment in the cavity; a small swab is not allowed to leave the hand of the surgeon or his assistant; the large swabs are introduced in any number, but a clip is at once applied to each tape, or to a group of two, three, or more tapes. The counting of the swabs under these conditions is not necessary, but it is as well to observe the ceremony, as it impresses upon all concerned the importance of being exact in such matters.

The swabs, after being made in the manner described, are

packed in a hold-all made of gamgee tissue, protected on the outer side by brown holland. The number in each package is always the same—two dozen of the smaller sizes, half a dozen of the larger size. In these packages the swabs are sterilised, three or four of the hold-alls being wrapped together in a strong, large towel. The sterilisation is effected in a pressure steriliser, a temperature of 250° F. being maintained for forty to sixty minutes.

It is important that as short an interval as possible should elapse between the sterilisation and the usage of the swabs. The most desirable, though not always the most convenient, arrangement is for the process of sterilisation to conclude within an hour of the operation, and for the packages to be taken from the steriliser forthwith to the operation room. But if this cannot be done, it is most desirable that the interval should not be more than one or, at the most, two days. After a longer period than this it is desirable to repeat the sterilisation. The same rules and procedure apply to the towels used during the operation. There should be an abundance of these, used to cover in the patient completely. These should be sterile, and their sterilisation should have been recently completed.

Instruments and Ligatures.—Everything used by the surgeon or by the nurses engaged in the operation should be sterilised. Bowls, ligature, and instrument dishes, jugs for saline solution, and similar articles should all be boiled. These are often large and even cumbersome in size, and their sterilisation by boiling is not easily effected. I have a large copper vat, measuring two feet by two feet by two feet, into which all bowls necessary for any operation are placed and therein boiled for thirty to forty minutes. If the operation should prove to be a septic one, as in appendix, or tubal, or gall-bladder operations, especial care is subsequently taken that all bowls, etc., are subjected to prolonged boiling. The washing-out of such basins with strong antiseptic solutions may be

soothing to the conscience of the surgeon or of the nurse, but it probably does not much affect the power of procreation of a pyogenic organism. Prolonged boiling is necessary.

Catgut. –During the last two years and a half I have used exclusively the method of Claudius in the preparation of catgut. The ordinary raw commercial catgut is steeped in a solution made by adding one ounce of iodine and one ounce and a half of potassium iodide to five pints of water, for eight to ten days. The crystals of potassium iodide and of iodine are together dissolved in about two and a half ounces of water, first, and the solution is then diluted to the requisite degree. The catgut may be kept in this solution for many weeks without undergoing any change for the worse. It can be used on the eighth day or on any subsequent day. I have tested this catgut thoroughly and am convinced, on experimental and clinical grounds, of its sterility. The instruction given by Claudius and all subsequent writers is to use one ounce of iodine and one ounce of potassium iodide; but with these proportions the full solution of the iodine is impossible.

Catgut is used for almost all ligatures. If anything stronger is needed, then Pagenstecher's celluloid thread is used. This is made in several sizes, but the thin and a medium size are all that are necessary. I use this material for all ligatures or sutures that require to be retained in place for more than a few days. The use of silk has been entirely abandoned by me for some years, as I find that the celluloid thread is more easily sterilised, that it presents a smoother surface, and that it is far stronger than an equal size of silk. The breaking of a Pagenstecher thread ligature or suture is an extremely rare occurrence; when it happens, it is almost certainly due to the fact that the thread has been boiled too often. The thread when wound on glass reels can be boiled for four or five operations, but after this it begins to fray and is then liable to break. It is, moreover, then most unsuitable for sutures, for the rough surface tears the peritoneum as it is being pulled through. This is the only

fault that the thread has, and as the thread is very cheap, it is better to throw it away, after being boiled three or four times, than to run any risk of its breaking.

Drainage Material.—During recent years a marked change has come over surgical opinion with regard to the question of drainage after abdominal section. At one time it was considered that drainage was the safeguard after all operations; that the provision for the free escape of inflammatory products made up for any slight fault in the operative technique. Now, thanks largely to the work of Clark and others who have studied the question with great care, we know that, when employed as a routine measure, drainage is rather a means of sepsis than a measure of escape from its effects. Drainage of the peritoneal cavity is very rarely necessary. The point will be dealt with again when we come to speak of the various operations; but, speaking generally, one may say that it is only for septic conditions that drainage is ever needed.

The best drain in the majority of cases is gauze. It absorbs well and conducts fluids away better than any other material. Its only disadvantages are that after remaining in the abdomen for a few days it is prone to become offensive, and its removal is difficult. In order to overcome the latter difficulty the gauze must always be surrounded by a rubber tube or by dental rubber. The two forms of drain which prove most satisfactory in general use are (1) the split rubber tube with gauze wick, and (2) the so-called "cigarette drain."

The split rubber tube may be of any size; as a rule, the larger the tube, up to a diameter of seven-eighths of an inch, the better. The tube is cut of adequate length, and a slit is made along it with scissors; within it a wick of gauze is then laid, to fit loosely in the lumen of the tube and to project for a couple of inches from each end. The gauze wick at one end of the tube is then carefully laid in position within the abdomen, and if necessary either the gauze or the end

of the tube may be fixed in position by a single catgut suture. This is especially necessary when the drain is needed at the upper part of the abdomen, as, for example, after cholecystectomy. The movements of the diaphragm, and the consequent up-and-down movements of the liver, are apt to displace the gauze or to roll it up into a ball which blocks the end of the tube. If fixed with a stitch this will not occur; the stitch, being of catgut, softens within five to eight days and the tube can then be removed. The cigarette drain is made in the following manner: A piece of dental rubber, well boiled, is cut about ten inches square. Over this a fourfold layer of gauze of the same size is placed. The edge of the two squares is then turned over, about one-fourth of an inch, and again over, and then rolled onwards until a cylinder of gauze and rubber is formed. A section of this cylinder shews a series of layers, alternately gauze and rubber, lying one within another. It is as though there were a series of rubber tubes, of gradually lessening size, each with its own wick of gauze, one within another. The terminal edge of the roll may be fixed with a stitch or with chloroform, a little gauze being turned in so that the edge of the outer rubber can be opposed to the underlying rubber and there fastened. This drain may also conveniently be fixed in any desired position with a suture of catgut. In cases of subphrenic abscess, or of localised perforation of the gall-bladder where the cavity to be drained is often extremely foul, the cigarette drain may be made slightly antiseptic by dusting a thick layer of powdered boracic acid, with or without a little iodoform, over the gauze before the rolling-up is begun. The ordinary form can be made some time before the operation, and sterilised just before usage. As a rule, however, I make the drain when I find that I want it, the materials for it being always ready to hand.

PREPARATION OF THE PATIENT.

In all cases an adequate preparation of the patient is most necessary. There are certain surgical emergencies, catastrophes like the perforation of a gastric or a duodenal ulcer or the rupture of a tubal gestation, in which the urgency of affairs does not permit of any elaborate detail to be observed. But, whenever time and circumstance and opportunity render it possible, the preparation of the patient, both locally and generally, should be most scrupulously observed. It is said by some surgeons that strict preparations are absurd, but there can be no question that they repay one in better results. The patient should be kept in bed for the whole of the day preceding operation, and for the afternoon and evening of the day before that. If the operation is to be done on, say, Wednesday morning, the patient goes to bed on Monday afternoon. He is at once given five grains of calomel, which is followed early on Tuesday morning by a full dose of saline aperient. Later in the morning if these have not acted, an enema of soap and water is given, and if the bowels are at all loaded, or the patient has previously suffered from constipation, the enema is repeated late at night. The condition of the mouth receives close attention. Every patient is given a new tooth-brush and a bottle of antiseptic mouth-wash on arrival in the Nursing Home or hospital, and the nurse is instructed to see that a thorough cleansing of the mouth is observed every hour or two during the day. It is astonishing to what a degree of uncleanliness even the better class of people will allow their teeth to go. Patients with gastric ulcer and its complications seem to suffer especially from bad teeth, and, indeed, the point is worth raising as to the degree in which oral sepsis may be a factor in the

causation of gastric ulcer. If the patient is in very feeble health, the nurse is instructed to clean the patient's mouth by frequent wiping with gauze or lint, and the patient subsequently rinses the mouth out. It is possible, as the excellent work of Dr. Harvey Cushing has shown, by careful attention to the condition of the mouth, and by the sterilisation of all foods, to render the alimentary canal comparatively aseptic. All patients from the moment they are received into hospital are fed on fluid diet, and everything given is sterilised, and the feeder or vessel from which the food is taken is also boiled.

I am disposed to think that the occurrence of parotitis and perhaps of pneumonia after abdominal operations is largely due to infection from the mouth. In some cases so foul a condition of teeth and gums may be accidentally discovered as to make a little delay in operating imperative. In one patient I found, quite by accident, a degree of suppuration in the mouth and a fœtor of breath that warranted a diagnosis of Riggs's disease. In such a case, and even in bad cases of carious teeth, an aspiration pneumonia is not unlikely to occur, or an extension of inflammation along Stenson's duct, unless a thorough and repeated cleansing is observed.

The skin of the abdomen needs, and must receive, very careful preparation. The hair is first shaved away from the whole abdominal wall and from the pubes. It is evidence of careless work to see only a patch shaved, one-half of the pubic hair, for instance, remaining untouched. It is well to limit the operative field, of course, but the preparation of the skin must extend widely beyond it.

A free washing with soap, and hot water frequently changed, is first necessary. The best material wherewith to wash is sterile gauze in large pads. These are moistened with hot water and rubbed with soap till a good lather is obtained. This washing should be continued for a

quarter of an hour, the water and the gauze being frequently changed. An antiseptic compress is then applied and left on for twenty to twenty-four hours, or until the movements of the patient begin to displace it. The compress consists of lint of two or three thicknesses, soaked in 1 per cent. formalin, 1 in 60 carbolic, or 1 in 2000 biniodide lotion. I prefer the former in the belief that there is by its means a deeper penetration of the skin and of the glands.

At the end of twenty-four hours there is a second washing, and a second similar compress is applied. This is removed immediately before the operation, when a third cleansing is made. The skin is now rubbed with spiritus saponatus—a solution of soap in spirit, a swab wet with 1 : 1000 biniodide solution being used to make a fine lather. This is wiped away with biniodide lotion; a little of the 65 per cent. solution of alcohol is poured over the skin, which is finally wiped over with sterile salt solution.

Some patients' skins are very tender and will not bear this preparation. If not, the second washing is omitted, for it is supremely important that the skin should not be roughened or chapped and that any irritative rash should not be caused. Overpreparation to the extent of damaging the skin is almost as bad as no preparation at all. If there are any small furuncles or septic cracks on the skin within the operation area, these must be carefully disinfected. The only satisfactory method of doing so is by means of the actual cautery, the point of the hot metal being kept in contact with the infected spot until all the septic matter is destroyed. When it is realised that the yellow spot in a furuncle may contain a pure culture of the *Staphylococcus pyogenes aureus*, the complete annihilation of such a colony is seen to be a desirable thing.

If the skin of the patient should be very rough, scaly, chapped, or cracked, its adequate preparation is almost

impossible. In these conditions, the "rubber dam" introduced by Dr. J. B. Murphy, of Chicago, will be found of the greatest service. It consists of a strong, very adhesive material which is stretched and then placed on the abdominal wall, to which it clings most closely, becoming, in fact, for the time, an inseparable part of this wall.

Through it the incision is made, and the hand lying outside, or any viscus escaping from the abdomen, lies, not upon the abdominal wall, but upon this sterile rubber dam.

As a general rule, no more preparations than those indicated are necessary, but in some few the general condition of the patient may be so enfeebled that special precautions are needed. It is a matter of the highest importance in all cases to ensure that the heart and the kidneys are acting well. Inefficient kidneys are among the most serious obstacles to success in any major operations, but especially in any abdominal operations. A routine and most exact examination of the urine for two or three days is therefore necessary. If the patient be feeble, or the heart so weak as to be a cause of anxiety, much good may be done by hypodermic injections of strychnine and digitaline for a few days before the operation. Five minims of the liquor strychninæ may be given three or four times daily. If the patient has been accustomed to alcohol, his usual quantity may be allowed him. All patients who are submitted to any abdominal operations are clothed in a suit of gamgee pajamas made for them by the nurse. After being made, of appropriate size, the suit is well warmed and is put on a few hours before the beginning of the operation. It is worn until all risk from the operation is past, and is then removed limb by limb. It is most important that all patients should be warmly clad in this way before, during, and after the operation.

OPERATION.

The operation, if possible, should be performed in a room specially furnished for the purpose. In a public hospital a well-equipped operation theatre is always provided. In a nursing home or in a private house it is sometimes necessary to operate in the patient's bedroom. The advantage of this is that it is less of an ordeal to the patient, who is sometimes alarmed at the prospect of being taken to a special room, and that there is less of lifting or of carrying after the operation. These trivial advantages are, however, greatly outweighed by the disadvantages, which are, that in the conversion of a bedroom into a theatre there is much traffic, many tables, instruments, etc., having to be taken into the room; that it is not possible to have all the needed appliances to hand with the same certainty, and that, finally, the smell of the anæsthetic clings to the room for many hours. An ordinary room in a nursing home can readily be converted into, and equipped as, an operation room to the great convenience of the surgeon. Such a room should be cleaned thoroughly and disinfected by formalin vapour at frequent intervals, and always after any septic operation. The operation table should have the foot towards the light, and should be of good height. Many of the tables are about three inches too low. If the table is high, it is more convenient and more comfortable for the surgeon, and if, for any brief manipulation, it is necessary for the surgeon to be at a rather high level, a plain metal or wooden footstool can be used.

The preparations for the operation must all be completed before the anæsthetic is administered, so as to ensure that the patient is not kept under the anæsthetic any longer than is absolutely necessary. The choice of the

anæsthetic is best left to the capable administrator of it, but in any special circumstances the surgeon should discuss the matter with the anæsthetist beforehand.

A competent assistant; a nurse to look after instruments, ligatures, etc. (this can be done by the surgeon himself if he so wishes); and a nurse who is to change bowls of saline solution, and generally fetch and carry, are all the staff necessary for any operation. The nurse who carries



Fig. 5.—The right way and the wrong way to carry a basin.

basins, etc., should be told to keep her hands away from contact with anything which is afterwards to be handled by the operator or assistants. Her hands, for example, should be outside a basin she is carrying; the thumbs should not be, as they often are, inside the edges of any vessel.

The abdominal incision is made in accordance with the principles mentioned elsewhere.

As soon as the abdomen is opened, a complete, or at least an adequate, examination of all the parts concerned

must be made. It is so easy to omit noticing points which are vital to the success of an operation. For example, an hour-glass stomach may well be overlooked; many such cases are recorded, owing to the fact that a dilated pyloric pouch has been mistaken for the whole organ. A single stricture of the intestine has been operated upon, when multiple strictures were present; and so with wounds of the intestine, one has been sutured, another left undiscovered. The appendix has been removed and a growth in the intestine left unrecognized. A gall-stone has been removed from the gall-bladder, and another left in the common duct. And so the list might be increased. A few minutes spent in painstaking examination of all the parts affected, or likely so to be, is well repaid in better results.

The lesion having been disclosed, the area to be operated upon is isolated. This should be done in a routine manner. In "packing off" the abdominal cavity from the parts immediately concerned, I always use two layers of sterile gauze swabs. Those first introduced are of large size, are well packed into position, and completely surround the field of operation. They remain unchanged throughout the operation. Each swab has a long gauze tape upon it, and to each tape a clip is fastened. On the inner side of this outer barrier of large swabs a layer of smaller swabs is placed; these are changed one by one as soon as soiled; and these, too, have each a long tape stitched to them. This method of placing a double layer of swabs is, I feel sure, the most satisfactory of all, and is the most efficient in preventing any soiling of the parts. It is important, too, to remember that the wound edges require protection just as much as the general peritoneal cavity and the viscera. The pus from an infected gall-bladder, or the fæcal matter from the intestine, if brought into any, the slightest, contact with the abdominal wall

will result in a suppuration of the wound, and not improbably in a weakened scar and a ventral hernia. The swabs must therefore be made to ensure protection for the wound edges.

The swabs when introduced must be wrung out of hot sterile salt solution (temperature about 105°–110° F.).

Instruments when boiled may be kept in a flat dish containing hot weak carbolic lotion, or may be spread out upon a dry sterilised towel; preferably the latter, for all operative work should be kept as dry as possible.

The operation should be conducted as speedily as is possible consistent with careful and complete work. An operator should always be speedy, never hasty. Speed should be the achievement, not the aim, of the operator.

THE TREATMENT OF ADHESIONS.

Adhesions are frequently encountered in all abdominal operations. They are, of course, the result of inflammatory conditions, sometimes recent, sometimes long past. The operation may be called for by conditions which are due directly and solely to the adhesions, or the adhesions may be a mere incident in the operation which is primarily directed to the removal of a different condition.

The question that arises is as to the manner in which such adhesions should be dealt with,—are they to be separated always; may they be ignored sometimes; or, after separation, shall something be done to substitute for one viscus another whose adhesion would be relatively unimportant?

When adhesions are encountered in a case of gastric ulcer it is almost always desirable to separate them. If, for example, an ulcer be attached by a stalk of adhesion to the under surface of the liver, the adhesion should be cut through, and probably the ulcer be removed. Such adhesions to the liver or the diaphragm may be, and not seldom are, a cause of great distress, of pains which radiate to the chest or elsewhere. A constantly

moving organ like the stomach cannot well brook interference. An anchoring of its walls to one spot is often the cause of much suffering. When such adhesions are separated, conditions remain behind which may set up fresh plastic peritonitis and new adhesions result. Even if such new adhesions form, it is probable that they will be less crippling than the old ones. But, in order to prevent their formation between the stomach and a fixed point, such as the liver or the diaphragm, the omentum may be folded over the bare or roughened area.

If adhesions around the gall-bladder are present when it is necessary to perform the operation of choledochotomy, the propriety of ignoring or of dealing with adhesions depends upon a variety of circumstances. If the patient be old, or feeble, or ill suited to long surgical manipulations, it is best to ignore the adhesions altogether and to perform the manœuvre of "rotation of the common duct" described elsewhere. Adhesions around the gall-bladder in a case of this kind are often very dense, exceedingly complex, and may involve the colon, which tears not unreadily if roughly handled. The gall-bladder in such a case has undergone sclerosis, and if stones be within it, they are of no great consequence. They have undergone, very often, what Mr. Rutherford Morison calls "the natural cure" and may safely be left undisturbed. These remarks only apply to the aged and enfeebled. In young, or middle-aged and healthly people, it is better to separate the adhesions, and, in addition, to perform cholecystotomy or cholecystectomy, as may seem best.

In cases of cholecystotomy, adhesions need not necessarily be widely separated, for it is not unlikely that they will re-form. They afford, meanwhile, a fairly secure barrier against any leakage into or infection of the peritoneum.

With regard to adhesions around the appendix, it is proper always to separate them and to remove the appendix. With the cause removed, adhesions, even if they re-form here, do not come in such denseness as before, and are probably only tran-

sient. I have certainly seen them disappear when the abdomen came to be examined later.

Adhesions are often said to result from surgical manipulations within the abdomen. If they do, I believe they are due to one of two chief causes, roughness in manipulation (that is, traumatism) or sepsis. In cases of carcinoma of the stomach when a preliminary gastro-enterostomy is performed, the abdomen is reopened in a couple of weeks for the purpose of performing partial gastrectomy. In such cases I have not seen adhesions of any kind. The amount of handling that is necessary for most operations can be borne by the peritoneum without any inflammatory response.

Dr. E. Wyllys Andrews has recently introduced an operation which he describes as "colohepatopexy or colon substitution." He considers that adhesions around the gall-bladder are unavoidable after operations thereon, and points out that such adhesions are only serious when they involve the stomach or the beginning of the duodenum. When the colon is implicated, there are no symptoms. His technique is:

1. A free incision, avoiding old scar.
2. Careful inspection of the position and the mobility of the stomach and separation of adhesions.
3. The transverse colon and the omentum are pulled up and thrust into the space between the pylorus and the liver. This new relation is maintained by suturing the colon and omentum to the gastro-hepatic ligament.

He then draws the following conclusions:

1. Gall-tract adhesions are inevitable after disease and operations.
2. They are beneficent, harmless, and symptomless in all but a few cases.
3. These few represent malposition rather than trouble from adhesions, *per se*.

4. The colon, gall-bladder, duodenum and pylorus can adhere to each other without impairing their function. The other parts of the stomach cause trouble if involved.
5. Such adhesions will re-form when separated unless the colon is substituted for the stomach.
6. The causing of colon adhesions to the liver does not disturb the function perceptibly.
7. Certain vague gastric disturbances have probably been treated by gastro-enterostomy when the patients would have had more benefit from this operation.

When adhesions are encountered they should be separated with great gentleness. This is best done by "wiping" them away with a piece of sterile gauze. Traction should always be avoided as much as possible, for it is productive of muscular spasm during the operation and of shock subsequently. Shock is very often the response on the patient's part to manipulations which would have been recognized as productive of severe pain if the operation had been performed without an anæsthetic.

DRAINAGE AFTER ABDOMINAL OPERATIONS.

The use of drainage in abdominal surgery has been frequently and fully discussed, and has attracted the attention of many laboratory workers. Opinion as to its worth has veered from one direction to another, almost at the caprice of fashion. At one time it was customary to drain after many of the simplest operations, if a few adhesions had been separated, or even the slightest damage inflicted upon the peritoneum. Lawson Tait, whose emphatic pronouncements rightly carried great weight, wrote, "When in doubt, drain." Doubt, in those early days, was the prevailing mental attitude and the result was, for a time, the almost constant employment of a tube. When a case "went wrong" if no drain had been introduced, the act of omission was held responsible for the disaster. The principles which underlie the use of drainage are now better understood,

with the result that drainage of the abdomen has very largely fallen into disuse. When a drain is introduced into the abdomen, whether gauze or a tube be used, certain results are constantly observed. There is, for twelve to twenty-four hours, a fairly profuse discharge of a serous, perhaps slightly turbid, or blood-stained fluid. After this time, the quantity gradually lessens and the drain is then generally removed. If the drain, however, be kept in, suppuration follows, the result of an inevitable infection. Since a general infection of the peritoneal cavity does not occur, it is clear that the pus comes only from the lining membrane of the track. It has been shewn by experimental work that the drainage material, whatever its nature, acts as an irritant. It is at once surrounded by the intestines and omentum from which a serous exudate occurs, and a local hyperæmia is observed. Yates describes the changes thus: "As the inflammatory reaction increases a fibrinous exudate is formed and there is more intense local congestion and some œdema. The serosa loses its lustre and is finally covered with opaque plastic fibrin. This fibrinous surface persists in the presence of smooth drains for at least seven days. Gauze, however, acts differently. The fibrin becomes incorporated in its meshes, followed by an ingrowth of granular tissue, so that, when the gauze is removed, instead of leaving a smooth, yellowish surface, it is rough and bleeding, with fibrin and superficial tags of granulation tissue still clinging to the more superficial portion of the gauze."

If the track left be examined after a gauze drain has been removed, some fine filaments of the cotton fibre are found. Infection of the canal filled by the drain is unfailing; it may be due to organisms escaping from the intestine, or to others which travel downwards from the skin. The organism most constantly found is the staphylococcus albus. Clark found, at autopsy, that infected pockets occasionally were found close to the drain track, and also that the organisms causing the peritonitis might persist in the drain track after they had disappeared from the general peritoneal cavity.

If, in dogs, a drain be introduced into the general peritoneal cavity and in eighteen or twenty-four hours a coloured solution be injected through a needle passed into the peritoneum just below the ensiform cartilage, none of the fluid passes out at the site of the drain, even when the general cavity is filled to its utmost capacity. A tube, it is clear, does not drain the general peritoneal cavity at all after this lapse of time. If during an operation for, say, general peritonitis due to appendicitis, tubes be placed in both the iliac fossæ, and another through a median incision into the pouch of Douglas, a stream of salt solution introduced into the general peritoneum will flow from all the openings. Temporary drainage of the peritoneum is therefore clearly possible. Experience shews, however, that all drain materials are speedly isolated and cease then to do more than drain the cavity which they themselves have produced.

Prolonged drainage of the general peritoneal cavity is a physical impossibility. The tube or wick of gauze is almost immediately isolated and it is not long before it is encapsulated. It provokes a copious thin discharge from the serous surfaces which surround it, forming, as Yates terms it, "a potential cavity which is speedily converted into an actual cavity" by the action of a plastic fibrinous exudate, forming encapsulating adhesions. Yates, after a very comprehensive discussion of the whole question, comes to the following conclusions:

Drainage of the general peritoneal cavity is physically and physiologically impossible.

The relative encapsulation of the drain is immediate.

The absolute encapsulation occurs early (less than six hours in dogs) and can be retarded but not prevented.

The serous external discharge is an exudate due to the irritation of contiguous peritoneum by the drain.

There is a similar inward current from the potential into the general cavity.

This external exudate diminishes remarkably with the formation of encapsulating adhesions.

These adhesions, under approximately normal conditions, form about any foreign body.

Their extent and density depend on the degree and the duration of the irritation of this body.

Primarily fibrinous, these adhesions become organised in a few days (three days in dogs).

If the irritation persists, they become progressively more mature fibrous tissue.

After irritation ceases, their disappearance depends principally upon a mechanical factor,—the ability of the involved surfaces to pull themselves or to be pulled loose.

Drains should be the least irritating, and should be gradually and finally removed as soon as possible.

Irrigation through drains is futile to prevent adhesions, and dangerous.

After a drain is inserted, all intra-abdominal movements should be reduced to a minimum.

As soon as the drain is removed, intra-abdominal activity should be stimulated, to aid in the disappearance of the remaining adhesions.

Peritonitis, if not too severe, possibly aids in the rapidity of the encapsulation of the drain.

A drain in the presence of infection is deleterious to peritoneal resistance, and should only be introduced to exclude more malign influences.

Postural methods, unless destined to facilitate encapsulation, are both futile and harmful, as far as drainage is concerned.

Peritoneal drainage must be local, and unless there is something to be gained by rendering an area extraperitoneal, or by making from such an area a safe path of least resistance leading outside the body, there is, aside from hemostasis, no justification for its use.

It is therefore clear that the use of gauze or rubber protective, or tubes of any sort left in the abdominal wound, should be restricted to those cases where it is necessary to exercise pressure to arrest bleeding; or to isolate a part of the peritoneum when a known infection has occurred; or when the escape of a fluid along a track isolated from the peritoneum is anticipated (as

in choledochotomy); or for temporary drainage of the general peritoneal cavity. The length of time during which drainage of the general peritoneum is possible has not been accurately reckoned, but it is almost certainly very brief, probably not more than twelve hours as a maximum.

AFTER-TREATMENT.

No small part of the success of all abdominal operations depends upon the after-treatment.



Fig. 6.—Position of a patient in bed immediately after the performance of gastro-enterostomy. As soon as the patient comes round from the anæsthetic he is propped up in this way.

As soon as the patient is returned to bed he is allowed to lie quite flat or with one small pillow for an hour or two, until the effect of the anæsthetic is passing away. Then two or three or more pillows are given and the patient is propped up with them. After all operations upon the stomach and after some upon the gall-bladder, the patients are almost in a sitting position. This is generally far

more comfortable for them, and does much to prevent the backache which many patients after abdominal operations complain of as their chief trouble.

Thirst is sometimes distressing within the first twenty-four hours; it is relieved by allowing the patient to flush the mouth out frequently with water, soda-water, or Giesshübler water. Nothing is given to drink until the feeling of sickness due to the anæsthetic is over, but after that there is little restriction as to quantity. A few sips of water are given at first, tentatively; if these are retained and there is no nausea, the quantity is rapidly increased, and after twenty-four to forty-eight hours a couple of pints of fluid may be given during the daytime. I do not think there is need to stint the patient in the matter of fluids, as was at one time the universal practice. It seems to me not improbable that death took place in some of the cases I saw, in my earliest experience, literally from starvation. There is no harm done, so far as I have been able to determine, by allowing the patient to drink freely, provided the risks of vomiting are over. The need for fluid is greater in patients who are weak and in much enfeebled health. In old patients, especially in malignant cases, I have often given a cup of tea, or some other favourite drink, to the patient within three or four hours of the completion of the operation of gastro-enterostomy, or partial gastrectomy, and nothing but good has resulted.

After the first twenty-four hours, milk, soups, and a little jelly or pudding may be given. The giving of solid food I generally delay for five to ten days, according to the condition of the patient and the nature of the operation. A few grapes or the juice of an orange may be given from the first, and, as a rule, are much appreciated. In the choice of fluid food during the first few days I leave much to the patient, giving her or him those things which by earlier questioning we have found to be liked.

If fluid food is withheld, as was formerly the custom, the amount of urine excreted is often very small. In a long series of cases operated upon in the Leeds Infirmary during the time I was a resident officer, I found that between ten and twelve ounces was the average amount passed in the first twenty-four hours. The excretion of urine is always diminished after any abdominal operation, but over a pint should be passed in the first twenty-four hours.

I do not allow the catheter to be passed, as a rule. If there is difficulty in voiding urine a hot fomentation will generally be helpful. If no urine is passed at the end of twenty-four hours or if the patient is uncomfortable, the catheter is passed, with all the usual precautions. Some patients are found to pass a small quantity of urine, three or four ounces, frequently. It will generally be found that they have an overdistended bladder, and catheterism will then be necessary.

An exact record should be kept of the amount of urine passed until all danger from the operation is over.

Rectal injections of saline solution are given almost invariably for twenty-four or forty-eight hours, until, that is to say, the patient is getting a fair quantity of fluid by the mouth. I do not give any form of nutrient enema, as a rule. Salt and water, one teaspoonful to a pint, with or without brandy, forms the usual enema. In quantity I give ten ounces or more as seems desirable, every three or four hours. Glucose may occasionally be given in the enema. It is water that is needed by the patient, and anything else given in a so-called nutrient enema is hardly of any value.

Every twenty-four hours the rectum is washed out with a pint of hot water and soap. If flatus cannot be passed freely, a tablespoonful of turpentine is added to the enema.

The rectal tube is passed occasionally if thought necessary.

The abdominal bandage is generally applied very firmly on the operation table, partly because the blood pressure is raised thereby and partly because a good support is given to the abdomen if there should be vomiting. If the bandage is found to be unduly tight, it may be loosened without disturbing the dressing.

If the pain is severe after the operation, I generally administer ten grains of aspirin by the mouth, and repeat it in a couple of hours if necessary. The administration of morphine is controlled by myself alone; without my express authority morphine is never given. The routine administration of this drug after abdominal operations is fraught with danger, for sickness the day following, flatulent distension of the intestines, and inability to express flatus are all caused thereby. Moreover, the surgeon may be blinded to the exact condition of the patient. I very rarely give any hypodermic injection of morphine during the first twenty-four hours after an operation; in old people, or in those worn by long suffering and feeble in health, a minimum dose—say, one-eighth of a grain—may suffice to relieve the worst of the pain, and to make the patient restful, even if sleep is not induced. When the first twenty-four hours are over the need for the giving of a sedative is over in almost all patients. If, however, on the second night, especially in the old or in those who are very ill, the patient is restless and wakeful, the sleep induced by one-sixth or one-fourth of a grain of morphine often works wonders. My feeling, therefore, about morphine is that if possible it should be avoided; that in nineteen cases out of twenty it can be avoided; but that given when necessary, given only with the immediate sanction of the surgeon himself, the benefit to be gained by it is often considerable. It is a most valuable drug, but one that is but rarely needed.

The time during which the patient is kept in bed varies

of course considerably, not only in different operations, but in different patients upon whom the same kind of operation has been performed. I find that it is a general custom to keep all patients in bed much longer than is necessary. If all is going well, the sooner a patient is up, the better. A patient, for example, after the removal of an appendix may be out of bed in six or seven days and may return to light work in a fortnight. A feeble patient, after the operation of gastro-enterostomy,—an old man with malignant disease, for example,—may be allowed to sit up in a chair on the fourth or fifth day. One patient, a medical man upon whom I performed gastro-enterostomy and cholecystotomy, was seeing patients on the fifteenth day after his operation, and, though this was done without my sanction, no ill effects followed. In all cases, however, the discretion of the surgeon must decide the practice in each individual case; no hard-and-fast rule can be laid down. All that can be positively said is that, provided all symptoms are favourable, there should be no unnecessary delay in allowing the patient to sit up.

If a patient is much enfeebled and wasted, I frequently order massage to the extremities within the first few days after operation. This is found most grateful to the patient, and prevents a feeling of extreme weakness when he is allowed to get out of bed.

During the whole of the time that the patient remains under treatment after operation the most scrupulous attention is bestowed upon the toilet of the mouth. The teeth are brushed frequently and some fragrant mouth-wash—listerine, for example—is used as often as possible. If the mouth is kept clean, the feeling of thirst is less noticeable. All fluid foods given are sterilised, both before and after the operation.

When drainage is employed, the gauze or tubes will need daily attention. If a drainage-tube is left in the

wound, to drain the gall-bladder or the common duct, its outer end is fitted into a bottle of about ten ounces' capacity, which is fixed by a safety-pin to the side of the dressing. During the first few hours bile may flow in very small quantity, especially in cases where the action of the hepatic cells has been in part suppressed by the tension and sepsis in the common and hepatic ducts, as a result of the occlusion of the duct by a stone. The bile that first flows may be muddy or turbid, but after a few days the bile flows in greater quantity and it becomes gradually clearer. The tube will then be removed if the stitch with which it is fixed has loosened.

If gauze packing has been used as a drain around the gall-bladder in cases of acute cholecystitis or elsewhere, it may be left until it has loosened -say, for eight days. Its removal then is almost painless. If the condition which has necessitated drainage is septic and offensive, a split rubber tube with a gauze wick will perhaps have been introduced; the wick may be removed early and the tube left for several days.

REFERENCES.

Yates, "Surgery, Gynæcology and Obstetrics," December, 1905, p. 473 (where a full list of references is given).

Clark, "American Journal of Obstetrics," 1897, pp. 481, 650.

CHAPTER III.

THE COMPLICATIONS AND SEQUELS OF ABDOMINAL OPERATIONS.

THERE are chiefly six:

1. Peritonitis.
2. Lung complications.
3. Parotitis.
4. Post-operative hæmatemesis.
5. Acute dilatation of the stomach.
6. Phlebitis and thrombosis.

Peritonitis.—The occurrence of peritonitis after abdominal operations has almost been abolished by the careful methods of modern surgery. In some cases, however, the risk of it cannot be avoided, for the operation may involve the handling of the lumen of the stomach or intestine which is septic, and from which the escape of organisms cannot wholly be prevented.

The careful preparation before operation will often effect a great reduction in the number and virulence of organisms in the stomach and the upper part of the intestine, as is elsewhere pointed out, but an adequate preparation is not always possible—as, for example, in cases of malignant disease of the stomach or in any form of acute disease of the stomach or intestine requiring urgent operation. The methods of preparation, the use of clamps to prevent leakage of contents in such operations, and the details of an aseptic operation faithfully observed have, however, done much to prevent the occurrence of any septic infection of the peritoneum. Nevertheless, peritonitis does occur, and is perhaps the most serious, if the least frequent, of all the complications of an abdominal operation.

It has long been a matter of earnest enquiry among surgeons as to whether it would not be possible, by some preventive inoculation, to render a patient more capable of withstanding the infection, during an operation, with any septic organisms. Experiments have been performed in the hope of discovering some means by which the danger of a peritoneal infection can be greatly diminished, and among these means prominence must be given to the production of hyperleucocytosis. The first investigators were Loewy and Richter, who attempted, by the injection of albumoses, especially spermin, to produce a hyperleucocytosis, and thereby to make the animals capable of resisting infection by pneumococci. Jakob, by the intravenous and subcutaneous injection of albumose into rabbits, made them proof against pneumococci and the organisms of mouse septicæmia. It was noticed that after each injection a hypoleucocytosis occurred first, to be followed speedily by hyperleucocytosis. If the infection was brought about during the time when the leucocytes were diminished, the animals without exception died; if, on the other hand, the infection was introduced during the time when the leucocytes were increased, the course of the disease was influenced in the most favourable way. Hahn succeeded in shewing that during the stage of artificial hyperleucocytosis, produced by nuclein and tuberculin, the blood of men and dogs possessed a higher bactericidal value than normal blood. Hofbauer, in Vienna, has obtained favourable results in undoubted puerperal septicæmia by the administration of five or six grains of nuclein by the mouth. After reviewing these facts Professor von Mikulicz, from whom they are quoted, writes ("Lancet," July 2, 1904):

"The question arises whether artificial hyperleucocytosis may not be of value in practice as a prophylactic. According to the above-mentioned experiments of Loewy and Richter, of Jakob and Hahn, one cannot exclude the pos-

sibility that, by a partly anticipated mobilisation of great masses of leucocytes, the latter may overcome the bacteria which had obtained entrance in the first instance in relatively small masses with greater ease than if the leucocytes delay their attack in force until the number and virulence of the bacteria in the tissues have markedly increased."

A series of experiments conducted by Miyake and authorised by Professor Mikulicz resulted in evidence that the injection of nuclein in animals prior to the infection of the peritoneal cavity by organisms had an undoubted effect in lessening the occurrence of peritonitis. Some of these experiments "consisted in performing a laparotomy and forcing through an opening in the stomach or intestine as much of their contents as could be obtained from the immediate neighbourhood of the incision. Of five control animals which had not been previously prepared, four died from peritonitis between five and sixteen hours after the operation. The fifth became extremely ill, but finally recovered, but the amount of intestinal contents which was transferred to the peritoneum was less in this case than in the others. Ten animals were prepared. These recovered without exception. The preparation consisted in three intraperitoneal injections of nucleic acid, two injections of neutralised nucleic acid. In each case laparotomy was performed seven hours after the injection. These experiments are such as to excite our interest in the highest degree, for by subcutaneous injections of nucleic acid it was possible to raise the resistance of the peritoneum to such an extent that even a considerable quantity of intestinal contents could be placed in the peritoneal cavity without causing damage, whilst without previous treatment an acute, rapidly fatal peritonitis followed almost without exception. This opens out a new field for the surgeon in preventing post-operative peritonitis."

In adopting the results of these experiments for the purposes of operations upon man, Mikulicz has administered fifty cubic centimetres of neutralised nucleic acid, 2 per cent.,

and has finally settled upon allowing a period of twelve hours to elapse between the injection and the operation.

In view of the novelty and importance of this subject, I may be permitted to quote the following summary of his experiments from Professor Mikulicz's article:

"The number of my experiments is not sufficient to permit me to form a definite judgment upon these points and to give an unguarded reply. We cannot, in the case of man, as we do in that of the lower animals when introducing infective material into the abdominal cavity, give a certain multiple of the minimum lethal dose in order to see how far a preventive treatment has succeeded. We set all our apparatus in action, in spite of preventive inoculation, to reduce infection to the minimum. Since this method fortunately succeeds in the majority of cases, even without preventive inoculation, in guarding the patients from a fatal peritonitis, a small number of satisfactory results do not prove much; but, on the other hand, one or two unsatisfactory results most certainly cannot condemn the method, for this method gives not absolute certainty like a specific immunisation, but only increases the natural immunity, and this may, in certain circumstances, even when increased to thirty-fold, nevertheless be insufficient. I have, however, the impression that the cases hitherto treated have given more favourable results, not only in the number of cases that recovered, but also in the progress of the individual cases, than the analogous cases of earlier date where the operation was performed without this preparation. In 10 cases of resection of the stomach for carcinoma, 9 recovered, 6 of them without the slightest complication. The progress was marked by a smoothness that was quite exceptional before this treatment was adopted. Two cases which presented exceptional difficulty in the removal of the carcinoma did undoubtedly within twenty-four hours develop peritonitis, with a pulse up to 160, which, according to our usual experience, foretold the most dismal prognosis. The patients fortunately survived this peritonitis. In the ninth case which recovered, the progress was disturbed from the fourth day by broncho-pneumonia.

The tenth case died; after seven days of uninterrupted progress he developed pneumonia, to which he succumbed three weeks after the operation. Of the remaining operations I should like to refer first to 22 cases of gastro-enterostomy and entero-anastomosis, 12 of which were for carcinoma. Of these cases, 19 recovered and 3 died. In all 3 cases death was most certainly not due to post-operative peritonitis, but in 1 case to perforation of an ulcerated carcinoma of the stomach two weeks after the operation; in another case, to continued hæmorrhage from a carcinoma of the stomach sixteen days after the operation; and in the third, to peritonitis arising from a tuberculous granuloma in the intestine four weeks after operation. Of 6 cases of resection of the intestines at one operation, 4 recovered and 2 died. In 1 case death occurred from collapse on the second day after a very prolonged operation of double resection for carcinoma; in the other case, where the injury was a bullet wound, death took place on the tenth day from hæmorrhage from the vena cava. In neither of the cases was there any peritonitis. One case of opening the stomach and stretching the cardiac orifice, performed on account of spasm, recovered. So also did 6 cases of operation on the bile-duct, 7 other operations upon abdominal organs without opening the intestinal tract, and 3 extra-abdominal operations. The last to be mentioned are two cases of nephrectomy, which were treated before the operation with nucleic acid. In both cases, in order to remove the suppurating kidney, the peritoneum had to be widely opened. One case recovered; the other died twelve days after the operation from hæmorrhage from the renal artery. In this case, too, there was no peritonitis. We therefore have 45 laparotomies in which the abdominal cavity was exposed to infection by the contents of the stomach or intestines or by some other infectious secretion; 38 of these cases recovered, and in none of the 7 fatal results was peritonitis the cause of death."

In addition to these measures there are others which have been used for the purpose of warding off an attack

of peritonitis or of combating its effects in the earlier stage. The chief among them is the inoculation with antistreptococcic serum. The use of this has been recently vaunted by Kader, but the general experience of surgeons tends to shew that it is of very little value, if, indeed, it has any value at all.

The free lavage of the peritoneum with hot saline solution, of which a large quantity is left within the abdomen when the wound is closed, has been shewn to lessen the likelihood of peritoneal infection, and to render the peritoneum better able to deal with the organisms which attack it. It has become a practice among many surgeons of great experience, Mikulicz among them, to employ this drenching of the peritoneum more and more. It is not a method which has ever appealed to me, and it is not my practice to flush the peritoneum except in infected cases.

Peritonitis is to be suspected when, after operation, pain, instead of subsiding, gradually becomes more and more intense, when the abdomen becomes prominent and tympanitic, and the intestines distended and motionless. In such circumstances the pulse gives the surest indication of the patient's condition. When the pulse rises steadily in frequency and its quality becomes progressively poorer, a most serious condition is present or impending. When the pulse-rate is below 100 there is, as a rule, no cause for anxiety; but with a pulse-rate rising gradually from 120 to 140 or even higher, in the absence of chest complications, the existence of peritonitis may be confidently predicted. The patient, as a rule, looks anxious and careworn and wears a frowning expression. Cyanosis and cold, clammy extremities indicate approaching dissolution. As a rule, there is some elevation of temperature in the early stages; but later the temperature may be normal or subnormal. It is a factor of little importance. The patient lies with

his hands above his head and his knees drawn up; straightening the thighs causes an increase in the abdominal pain. Vomiting and hiccough are sometimes persistent. An ounce or two of fluid, perhaps stained black by digested blood, may be vomited every few minutes, and, though lavage relieves this symptom for a time, it is almost certain to return. As the toxæmia deepens the patient gradually becomes numbed to his pain, and will often express himself as feeling much easier; this is a bad sign. The skin is dry, until near the end, when a cold sweat covers the patient. The tongue is dry and coated, and the secretions all are scanty. It is, however, the steadily increasing rapidity in the pulse-rate, together with a steady fall in the character of the pulse, that gives most cause for anxiety.

As soon as the indications of a commencing peritonitis are observed, measures must at once be taken to secure a free action of the bowels. If a copious evacuation of flatus or fæces can be compelled, the great probability is that the patient can be saved. Unfortunately, the administration of any aperient by the mouth is little likely to be of use, for the drug will often be vomited within a few minutes. Enemata containing turpentine or enemata of oil introduced high into the colon are the chief measures upon which reliance must be placed. One of the things most needed in therapeutics is an aperient that can be administered hypodermically.

Is it worth while, in cases of general peritonitis, to reopen the abdomen and to attempt to cleanse and to drain it? The infection which underlies the symptoms mentioned above is so universal that any operative treatment would be in itself a most hazardous procedure, when applied to a patient who has already borne the strain of a serious operation. In the early stage of these cases one has hope of being able to cut short the disease by brisk purgation. When this has failed, the patient's con-

dition is such that little hope of relief can be entertained. There are cases, however,—though in my opinion they are extremely few,—when a reopening of the abdomen is not only justified, but is absolutely necessary if the patient is to be saved. These are the cases where the infection can be traced with reasonable certainty to a definite source; such as, for example, leakage from the giving way of an anastomosis accomplished by the Murphy button or by suture, or soiling due to the escape of infective material from the intestine during the operation. In such circumstances the continued infection must be stopped by appropriate measures of repair, and the soiled parts must be thoroughly cleansed, and, if need be, drainage must be established.

Lung Complications.—Chest complications formerly occurred frequently after abdominal operations. In the surgery of the present day their occurrence, though greatly diminished, is still far greater than it should be.

The following lung complications are known to follow any abdominal operation: pneumonia; pleurisy; bronchitis; œdema of lungs; abscess of lung. Any one of these may follow a simple or a serious operation, a short or a prolonged one. The cause of the lung implication has been closely investigated, and a variety of explanations have been offered. The suggestion was long ago put forward with confidence that the anæsthetic was the responsible agent. The chilling and irritating effect of ether upon the mucous membrane of the respiratory tract resulted in a profuse secretion from the inflamed surface. It was not long, however, before it was found that all these chest troubles might follow upon operations which were performed under local anæsthesia alone.

It is well known that for a few days after any abdominal operation the wound may feel stiff and sore, though it is not actually painful. The taking of a deep breath or

the act of coughing causes a sudden "stitch" in the wound, and the patient feels as though a free effort at coughing would tear the wound edges apart. It was suggested then that the immobilization of the abdominal muscles, in the unconscious protection of the wound area by the patient, resulted in an accumulation of the bronchial secretions in the lung. A deep breath was not taken; the breathing remained thoracic in type, and the air-passages were not cleared in the act of coughing. The lung then became irritated and waterlogged by retained secretions. In favour of this suggestion is the fact that all forms of chest involvement are more frequent after operations performed in the upper abdomen.

A factor which is, without question, one of great importance is the chilling of the patient before, during, and after the operation. It was, at one time, the custom in many hospitals to send all the patients to the bath on their arrival. After the bath, a thin cotton shirt was given to them—no matter what form of clothing had been worn on admission. Furthermore, during the operation, in a room perhaps not overwarm, a considerable part of the patient's body was exposed, and if the cleansing of the skin were done by a house-surgeon fond of a splash, a pint or two of lotion was allowed to run down underneath the patient. A thinly clad patient, most of whose abdomen was exposed, was, therefore, lying on a cold, damp table for perhaps an hour—a most unsatisfactory condition of things.

The patient should have warm clothing on arrival; before the operation he should be clad in a suit of gamgee pajamas; as little of the abdomen as possible (though as much as is necessary) should be exposed; the operation room should be well warmed; if necessary, the table should be a hot-water table; operations should be done expeditiously. There should, moreover, never be undue exposure

or handling of viscera, so that no unnecessary shock may be caused.

In some cases I feel sure that the cause of the lung implication is to be found in the inhalation of septic matter. This septic matter may come from the patient's own mouth, or it is conceivable that a dirty inhaler may be responsible for it. Of the necessity for cleanliness in both these directions there is no further need to speak.

In some cases the pneumonia has been proved to be due to embolism, the septic emboli being derived from the operation area. In operations upon the stomach or intestine in particular, thrombosis of veins may result from unduly rough handling or from infection of the wounds. Neatness and a certain dainty fastidiousness and the utmost cleanliness in all operations are things to be cultivated.

There can be little doubt, I think, that in some cases the long continuance of the Trendelenburg position in pelvic operations is productive of harm. The viscera are pressed against the diaphragm, whose freedom of action is thereby limited. There is congestion of the lungs as a result of the gravitation of blood to the dependent parts. It is my custom to perform the early and late steps of any pelvic operation with the patient in the usual horizontal position. As soon as the Trendelenburg position is necessary, the table is altered by the anæsthetist in a moment; as soon as the pelvic part of the operation is completed, the table is again made horizontal. The patient, therefore, remains the briefest possible time in this constrained position.

It has become a general custom, more especially among resident officers, to give intravenous saline injections to all patients who are suffering in any serious degree from shock. The custom has much to recommend it, but I am strongly disposed to think that it is not seldom provocative of harm, for, in some cases, when large quantities of

fluid are injected, an acute œdema of the lung, with copious frothy expectoration, occurs. On postmortem examination of such cases it can be seen that there is an acute œdema of both lungs; the lungs, in fact, are waterlogged. Saline infusions are remedies we cannot afford to do without, but a little more discretion than seems to be generally customary should be exercised in their administration. Above all, it should be seen that the fluid injected is of proper temperature, that no air is allowed to get into the vein, and that the quantity injected does not exceed three pints. As much as five or six pints has been frequently given; but I do not think that as much benefit results from one large injection as from two smaller ones given with an interval of twelve or twenty-four hours.

Professor Mikulicz orders all his patients, after abdominal operations, to breathe deeply for a few minutes two or three times daily in the belief that the tendency to stagnation in the lung bases is thereby relieved and broncho-pneumonia prevented.

From the foregoing discussion it will be realised that, though the possible causes or influences giving rise to the lung complications after abdominal operations are many, it is not to any one of them that paramount importance can be attached. The surgeon's part, therefore, must be to safeguard his patient by all the means in his power from all these harmful influences; and he will find that by so doing the risk of the occurrence of these most serious disasters will be greatly lessened, if not entirely abolished.

The treatment of the lung complications following abdominal operations does not differ from that which is observed in the cases as they are ordinarily seen.

I have come to place much reliance upon the frequent use of the steam inhaler with or without tincture of benzoin or other stimulant. The patient always expresses himself

as much relieved by it, and a copious expectoration generally results from each use of the inhaler. A mixture containing digitalis, vinum ipecacuanhæ, and carbonate of ammonium generally gives relief.

Bibergeil ("Archiv f. klin. Chir.," Bd. lxxviii, Heft 2, and "Brit. Med. Journ.," Epitome, March 17, 1906, p. 41, No. 170) publishes the results of an analysis of 3,909 abdominal operations, including those for strangulated and reducible herniæ, practised in Körte's clinic, and points out what he concludes to be the most likely causes of postoperative pneumonia in this class of cases. Notwithstanding the protection afforded by modern aseptic methods against peritoneal infection, this pulmonary complication occurs, it is stated, more frequently after laparotomy than after any other major operation. Pneumonia followed in 135 of the collected cases, and presented in 10 instances the croupous or lobar, in 98 the lobular, and in the remaining 27, the hypostatic, form. Other complications such as pulmonary embolism and abscess, bronchitis, pleurisy, and empyema, occurred in 147 other cases. In this study of the causes of pneumonia in abdominal surgery, the author finds that the occurrence of this complication is not influenced in any way by the condition of the wound. Of 10 cases of the croupous and distinctly septic form of pneumonia, 8, so far as the seat of operation was concerned, were aseptic, and 2 only were septic. Careful study of the collected cases of postoperative pneumonia has led, he states, to rejection of the views that this complication may be due to infection by way of the lymphatics, and to such causes as exposure to cold of the surface of the body or of the peritoneal cavity, to abdominal irrigation, and to direct action of a general anæsthetic. The lobular form, or bronchopneumonia, which is most frequently met with after laparotomy, is regarded as being usually the result of autoinfection, due to aspiration of secretions from the mouth and pharynx, whilst the patient is under the full influence of an anæsthetic. It is pointed out that the interference with free breathing and ex-

pectoration resulting from pain at the seat of operation and impeded movements of the incised abdominal wall, must favour very much the development of lung disease after laparotomy, whilst the resistance to the inflammatory attack is in many cases much impaired in consequence of the enfeebled condition of the patient. In concluding, the author recommends, as suitable prophylactic measures, thorough cleansing of the mouth and throat and irrigation of the stomach before the operation; a cautious administration of the anæsthetic, the patient's face being turned to one side to permit a free external flow of oral secretion; prevention of chilling of the surface of the abdomen during and after the operation; the application of thick and warm compresses to the wound, and avoidance of tight bandaging; frequent change of the patient's position in bed during the after-treatment; and as speedy a release from the recumbent posture as the state of the wound will allow.

Parotitis. —An acute attack of inflammation in one or both parotid glands may follow upon an operation upon any abdominal organ. I feel sure that the frequency of this most trying complication is decidedly less than it was.

In 1887, Stephen Paget collected the records of 101 cases, and investigating their causes, found that in—

10 cases parotitis arose after disease or injury of the urinary tract.
18 " parotitis arose after disease or injury of the alimentary canal.
23 " parotitis arose after disease or injury of the abdominal wall, peritoneum or pelvic cellular tissue.
50 " parotitis arose after disease or temporary derangement of the generative organs.

The preponderance in this series of cases following upon operations upon the ovaries was doubtless due to two facts,—one, that at the time these cases were recorded abdominal surgery was confined very largely to the pelvic organs; the other, that the starvation of the patient was considered a necessary incident of success; no drop of water was given, perhaps for days, and the mouth was parched, the tongue dry and hard. In those days the surgery of the stomach and gall-bladder was

in its earliest infancy. Operations were few, and patients were not often fortunate enough to survive to develop parotitis.

The time of the appearance of the inflammation is usually towards the end of the first week after operation, but cases are recorded in which the inflammation began at the end of six weeks. In about one-third of the recorded cases both glands have been affected, the involvement of one preceding that of the other by two or three days, as a rule.

The causes of secondary parotitis remained long obscure. It was at first regarded merely as a variety of mumps, or primary parotitis, until experience shewed that there were two very marked differences between them,—primary parotitis being an infectious and non-suppurative disease, secondary parotitis being non-infectious and prone to suppurate. Three chief theories have been held with regard to the nature of this disease.

For able discussions of this subject see Dyball, "Annals of Surgery," vol. xl, p. 886, and Rupert Bucknall, "Lancet," vol. ii, 1905, p. 1158, to both of whom I am indebted for some of the following particulars:

1. *The Pyæmic or Embolic Theory.*—This was the first of the theories to receive general approval. It was universally recognized at one time that secondary parotitis occurred in association with operations where suppuration took place, and it was not unnaturally supposed that the incidence of this phenomenon was due to septic embolism of the parotid vessels, the infected clots being derived from the neighbourhood of the suppurating wound. But the objections to this view were soon recognised to be two,—secondary parotitis was known to follow operations where no obvious infection had occurred, when no evidence of thrombosis was present; and in fatal cases, even when there had been suppuration in the original wound, there was sometimes no sign of venous thrombosis, and no discoverable source there, or elsewhere, of septic emboli.

Undoubted instances of pyæmic infection of the parotid gland

have occurred, but the glandular infection has only developed at a late stage of the disease and long after other parts have suffered.

The known facts, therefore, with regard to secondary parotitis were that it occurred apart from other pyæmic manifestations in the great majority of cases; that, in fatal cases, no source of infected emboli could be discovered; that in cases where me-

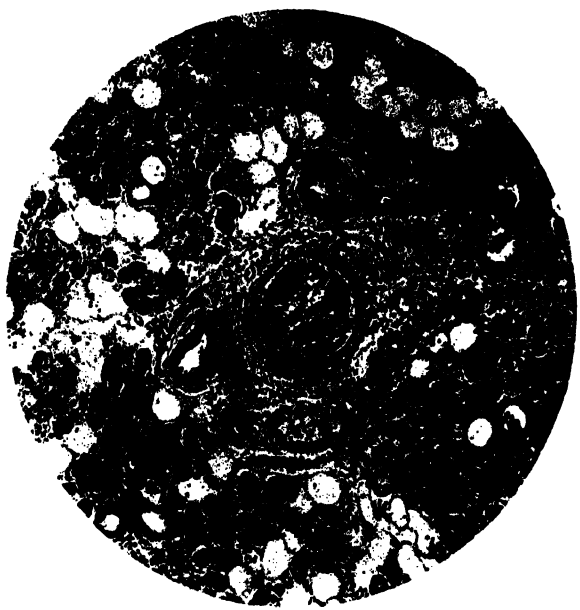


Fig. 7.—*Parotitis, early stage.* Vessels normal; small duct blocked with débris; walls breaking down; tissue around inflamed and infiltrated with small round cells; large duct blocked with débris, containing organisms to high power; blood-vessel unaffected (Rupert Bucknall).

tastasis undoubtedly occurred other parts than the parotid were affected, and were affected at an earlier stage. Bucknall writes:

"More recently the question of embolic origin has been definitely proved to be incorrect, for it has been shown by microscopic examination that the conditions present are different in secondary parotitis, and in parotitis of pyæmic origin. In the former instance the process of inflammation begins around the ducts in the centres of the lobules, and, moreover, many lobules are simultaneously affected. In the latter the inflamma-

tion begins around the arteries which run in the perilobular tissue and the inflamed mass is a single one, involving the area of gland-tissue supplied by the particular vessel which has become blocked with septic clot."

2. *The Sympathetic or Reflex Theory.*—This theory owes its origin, or at least its chief advocacy, to Stephen Paget. It rests upon a supposed sympathy existing between the parotid

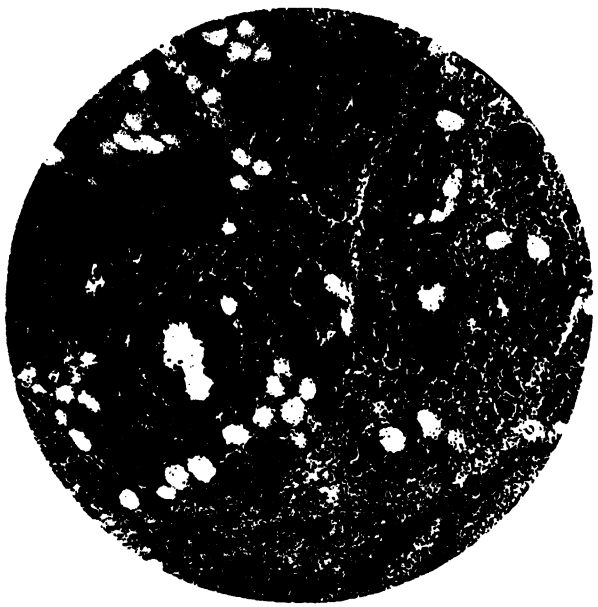


Fig. 8.—*Parotitis, more advanced.* Infected ducts and adjacent central parts of lobule breaking down to form abscess cavities (Rupert Bucknall).

glands and the generative organs, and in support of it is quoted the known relationship existing between mumps and orchitis or ovaritis. Such a view as this, however, is not in accordance with modern pathological views. A closer investigation of the so-called "sympathetic" affections shews that it is infection, and infection alone, which is the cause of the acute inflammatory manifestations. The appearance of a theory such as this was perhaps not surprising at a time when, as I have said, almost all abdominal operators were concerned with the generative organs of the female.

3. *The Duct-infection Theory.*—The suggestion that secondary inflammation of the parotid was due to direct infection of the gland by the invasion of the duct by organisms from the mouth was made by Hanau and Pilliet in 1889. So good an account of this view is given by Bucknall that I take the liberty of quoting it in full:

They found on microscopical examination of sections of the parotid (1) that the ducts were choked with débris containing



Fig. 9.—*Parotitis, late stage.* Gland tissue destroyed and replaced by inflammatory products, which are breaking down to form abscess cavities; vessels not thrombosed or specially inflamed (Rupert Bucknall).

micro-organisms; and (2) that the inflammatory processes present invariably began around the ducts in the centre of each lobule and only spread later to the periphery of the lobule and the perilobular connective tissue in which the blood-vessels are situated. They concluded, therefore, that secondary parotitis could not be of embolic origin, or else the inflammation would have originated around the vessels, and that the fact that inflammation began simultaneously in the centres of many lob-

ules at once, pointed to an ascending infection of the ducts as the real source of the affection,—a conclusion which was further borne out by the actual presence of micro-organisms in the ducts themselves in such cases.

Additional evidence of different kinds has been subsequently brought forward in support of this view.

(1) Microscopic sections serve to show that in all cases of secondary parotitis the disease pursues the following course: (*a*) The ducts become blocked with débris containing micro-organ-

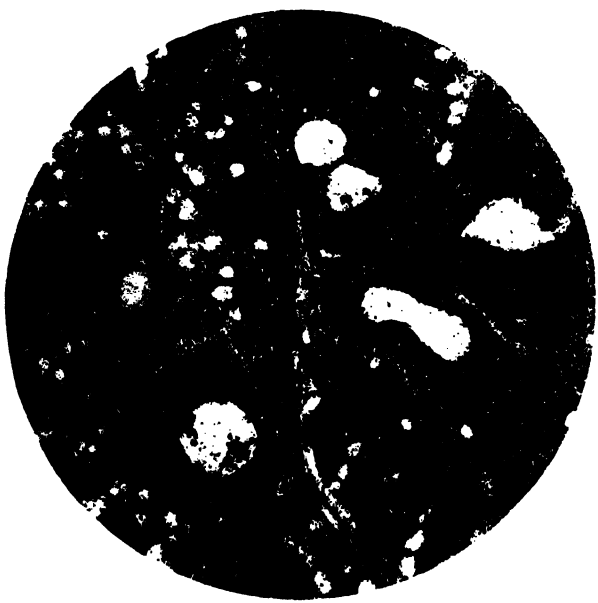


Fig. 10.—*Parotitis, late stage.* Shewing multilocular abscesses in sites of ducts and general small cell infiltration of lobules (Rupert Bucknall).

isms. (*b*) Inflammation first begins in the centre of each lobule around the ducts, and at a point farthest away from the vessels. (*c*) Many lobules are simultaneously affected; they each become centrally necrosed and then, finally, by extension they fuse to form a multilocular abscess cavity.

(2) Bacteriological examination, first carried out by Girode, has served to prove: (*a*) That several different kinds of organisms may give rise to secondary parotitis, the commonest

being the staphylococcus, the next frequent the pneumococcus, and after that the pneumobacillus, the typhoid bacillus, the colon bacillus, and the streptococcus, in order of frequency. (*b*) That on taking cultivations from the gland itself, the pus contained in it, the orifice of Stenson's duct, and the oral cavity respectively, the organisms found at each spot are invariably identical in each individual case, a fact which supports the conclusion that the infection of the gland spreads from the mouth via the duct. (*c*) That the organism giving rise to secondary parotitis is by no means invariably the same as that giving rise to the primary disease during the course of which the attack of parotitis has arisen. Thus, in the cases complicating pneumonia the organism causing parotitis may be the pneumococcus or the staphylococcus; in typhoid fever it may occasionally be the typhoid bacillus, but it is much more commonly the staphylococcus or pneumococcus. In embolic parotitis due to pyæmia, on the other hand, the organism in the parotid is invariably identical with that giving rise to the primary disease and the abscesses in other parts of the body.

Microscopical or bacteriological evidence of direct or ascending infection has been brought forward by the following observers: Girode (12 cases), Prantois (2 cases), Diaz, Swain, Bosquier, Morley, and Subkovski. Toupet, Testa, Subkovski and Fischel found the pneumococcus in the gland in cases of lobar pneumonia, and Janowski and Lehmann found the typhoid bacillus in cases of enteric fever. Girode, on the other hand, found the staphylococcus to be the cause of the parotid infection in a case of pneumococcus pneumonia, and the pneumobacillus to be present in the gland in a case of puerperal septicæmia of streptococcus origin. Various observers, moreover, have shown that parotitis complicating enteric fever is far more frequently due to the staphylococcus than the typhoid bacillus.

Post-operative Hæmatemesis.—Hæmatemesis which follows upon operations upon the stomach, and is obviously due

to the improper or imperfect application of sutures in the formation of an anastomosis between the stomach and the duodenum and jejunum, is not considered in the following remarks.

Post-operative hæmatemesis follows far more frequently upon operations involving the opening of the abdomen than upon any other operations. It is true that cases of even fatal hæmatemesis have occurred after operations upon the bladder or urethra, upon the head, and upon the extremities; but all these cases together do not, in number, form a tithe of those which are seen after abdominal operations.

In the majority of instances hæmatemesis begins within twenty-four hours of the operation. The blood which is vomited has always been in the stomach a sufficient length of time to become partly digested, the result being that the vomit is always black. "Black vomit" is the name by which the condition is chiefly known by nurses. The patient may or may not have suffered from ether or chloroform sickness; but, whether he has or not, there is usually an interval between the cessation of this and the commencement of the hæmatemesis. As a rule, the amount vomited is small; there are rarely more than two to five ounces at a time. The characteristic condition is for an ounce or two to be vomited at frequent intervals. The vomit is often intensely acid, and burns the patient's mouth, throat, and lips. In many cases a broad, red mark on the chin or cheek will shew where the vomited fluid has run down to the basin, and the lips often become swollen, red, and very tender, for the patient makes little or no effort to expel the fluid, allowing it to trickle away from his mouth.

The general condition of the patient is always bad. The aspect indicates a condition of profound depression. The pulse is small and rapid, the skin cold and moist,

the limbs clammy with sweat. The temperature is often subnormal. There is, as a rule, a rapidly progressive collapse. Indeed, in the severest cases one cannot but feel that the patient is the victim of a profound toxæmia—that a poison of unusual virulence is killing him. Patients are often curiously sensitive to all impressions in the early stage—their mental alertness is remarkable, but their comments soon become spasmodic and jerky, and *mal à propos*, and lethargy, dulness, and general inertia rapidly follow.

In a very large number of the recorded cases a fatal issue has occurred. In a series of twenty-nine cases referred to by Purves ("Edin. Med. Jour.," March, 1902) the death-rate was equivalent to 69 per cent., and this estimate is approximately that which is given by the majority of writers, though from my own experience I believe it to be a gross exaggeration. Hæmatemesis follows upon any abdominal operation, but is more especially to be looked for when the stomach, duodenum, or bile-passages are the seat of disease. The time of onset, though usually within the first forty-eight hours, may be delayed for as long as ten days.

The cause of the hæmatemesis is not definitely known. A great variety of theories have been suggested. Among them are the following:

Firstly.—It has been suggested that the anæsthetic is the cause of the bleeding. It is, however, an undoubted fact that precisely the same symptom may be observed when the operation has been performed under cocaine.

Secondly.—Distinct injury to the stomach or duodenum is said to result in ulceration, from which the blood comes. In some cases an ulcer or several ulcers have been found on postmortem examination. It is suggested that the damage done to the stomach produces a local necrosis, and that the gastric juice then digests the slough, and an ulcer results. Krönlein, however, has shewn that, in order

to produce ulcers in this manner, several days must elapse between the time of the receipt of the injury and the time when an ulcer is found. Though this explanation may be acceptable for some cases, it cannot, therefore, apply to them all.

Thirdly.—The suggestion put forth by von Eiselsberg—who, in 1899, first drew prominent attention to this symptom—was that injury to the omentum was the immediate cause. Rough handling or twisting or ligation of the omentum produced a thrombosis of the omental vessels followed by embolism in the wall of the stomach, and in consequence ulceration of the stomach resulted. Purves writes on this point:

"In reference to the stomach, in particular, von Eiselsberg considers that, after ligature of the omental branch of the epiploïc artery, the vessel becomes thrombosed and the thrombus extends back to the origin of the vessel. The vessels lie at right angles to one another, and he conceives that a portion of the thrombus projecting into the epiploïc may be swept off into the passing stream and carried on into some of the branches going to the stomach-wall, there to form a thrombus and ultimately a digestive ulcer. He considers that this is the most prominent etiological factor in the production of post-operative hæmatemesis."

The suggestion is one which, doubtless, contains some measure of truth, but it is not, of course, applicable to all cases.

Fourthly.—W. L. Rodman has suggested that sepsis is the chief cause. This seems to me to be the most likely of all the explanations that have been given, though it cannot be denied that in some instances the obvious evidences of sepsis elsewhere are wanting. In some of these cases it may be that the sepsis is of such a character as to produce a rapidly fatal toxæmia, the poison acting

so rapidly, indeed, that local evidences—peritonitis, etc.—have no time to develop.

Fifthly.—Mayo Robson, disputing the theory suggested by Rodman, writes: "The only explanation that seems at all feasible is that the hæmorrhage is dependent on a reflex nervous influence." The apt comment of Purves on this statement is—"This is no more easy to prove than the other suggestions; but, if it were a true solution of the question, it is, I think, admissible to suppose that sepsis would, in many cases, determine the onset of the reflex or prolong the duration of its action, and thus render the condition more serious."

The treatment of hæmatemesis will depend in part upon the condition of the patient. In those whose condition is fairly good, lavage of the stomach with a tepid solution of bicarbonate of soda will generally arrest the sickness and give relief. The bowels should be compelled, if possible, to act freely; high enemata of soap and water or oil must be given. Sips of water containing adrenalin chloride solution—ten minims to a teaspoonful—should be given every half-hour; the general and the local effect of this drug are both desirable. Calomel may be given in doses of one-half grain every half-hour.

The abdominal bandage should be applied firmly—as firmly, indeed, as the patient can bear it.

If the symptoms of toxæmia are well marked, an intravenous infusion of saline solution will prove of value.

Reichard has reopened the abdomen in two cases for the purpose of searching for the source of the hæmorrhage in the stomach. This is a futile and useless procedure.

Acute Dilatation of the Stomach.—This is among the least frequent but most serious complications which may follow upon an abdominal operation. A large number of cases have now been reported, and an excellent review of many of them published by Campbell Thomson ("Acute Dilatation of the Stomach;" Bailliére, Tindall & Cox, London, 1902).

Symptoms.—The symptoms appear as a rule rather insidiously after an abdominal operation. The chief of them are pain in the epigastrium, constant, effortless vomiting of a thin greenish or greyish turbid fluid, a rapid and steadily increasing pulse-rate, and symptoms of collapse or exhaustion. The act of vomiting is not often distressing though its frequent repetition may be exhausting. As Henry Morris remarked of one of his cases, the vomit is brought up "in large gulps without straining." The surgeon's attention should be drawn to this complication by the repeated vomiting and the constantly increasing pulse-rate. An examination of the abdomen will then reveal a tight distension of the epigastrium, and when the bandages are removed, the outline of the grossly inflated stomach may be marked. The passage of the stomach tube allows a huge volume of gas to escape, often with a miniature "report," and a large volume of thin greyish fluid will be evacuated. As soon as the tube is withdrawn, the stomach may begin almost at once to refill, and within half an hour its distended form may be recognised upon inspection of the abdomen. When the stomach distension becomes, as it may, gigantic, the bulging of the abdominal wall is mostly to the left and in the lower half; the right hypochondrium by contrast has been said to be flattened or excavated. In other cases, though the abdomen is large, tense, and resisting, no special bulging at any point can be seen, while in yet others the abdomen may be, as in Henry Morris's case, retracted. In this instance, at the postmortem examination, although the stomach was enormously dilated and occupied the greater part of the abdomen, its anterior surface was said to be flattened.

The general condition of the patient is recognised as being serious from the first. The respirations are frequent and shallow; the pulse is rapid, thready, and of poor quality; the aspect of the patient shows that his tissues are starved of water; he is pinched and careworn and old in appearance, and the limbs are often cold and clammy. Thirst is intolerable and unquenchable; the patient is restless, and at times irritable and weary. Diarrhœa has

been occasionally observed. The amount of urine in nearly every instance in which special attention has been given to the point has been very considerably reduced in quantity, or the secretion entirely abolished.

Pathology.—The appearances presented on postmortem examination are curiously similar in almost all cases. The stomach is enormously distended, and is sharply bent upon itself, so as to form a gigantic U-tube, whose distal limb is rather shorter



Fig. 11.—Acute dilatation of the stomach (Campbell Thomson).

and less thick than the proximal. At the lesser curvature there is therefore a sharp kink. The stomach seems to occupy the greater part or even the whole of the abdomen, cutting off from sight and severely compressing all the small and large intestine. The walls of the stomach are tightly stretched and thinned, in one case seeming no thicker than a single layer of peritoneum. The thinning of the walls is not equally distributed; very thin patches are sometimes seen, the greater part of the stom-

ach remaining normal, or nearly so. In 12 cases out of 44, the dilatation was not limited to the stomach, but involved the duodenum also, and in one case the upper few inches of the jejunum. Box and Wallace have shown that the condition found in acute dilatation of the stomach can be exactly reproduced on the cadaver. They write:

"We have found by actual experiment on the cadaver that the stomach can be enormously distended by water pressure, with the jejunum cut right across and lying patent in the abdomen. Moreover, the stomach remains thus distended. The same result can be attained after the superior mesenteric vessels and the peritoneal folds in their neighbourhood have all been divided. If, however, by introduction of the finger well behind the distended stomach a little to the left of the mid-line of the spinal column, the fundus and posterior wall of the stomach be gently raised, the excess of fluid will at once flow freely away from the stomach through the cut jejunum. If the part of the duodenum which lies on the right side of the spine, behind the peritoneum, be first incised, the tense distension of the stomach cannot be produced. We therefore feel justified in assuming that the tense distension is due to actual pressure of the stomach on the part of the duodenum which crosses the third and ascends by the side of the second lumbar vertebra to end in the jejunum.

"We would suggest, therefore, that in producing the train of symptoms met with in acute dilatation of the stomach two factors come into play. There is, first, a paralytic condition of the viscus which leads to distension, and then, at a certain stage, the distended stomach actually produces obstruction by pressing on the duodenum on the front and to the left of the spinal column." ("The Lancet," November 9, 1901, p. 1260.)

A large number of more or less ingenious hypotheses have been suggested to explain the incidence of acute gastric dilatation, but none of them are completely satisfying.

By Fagge and others an excessive secretion of the stomach was considered the primary factor, the organ being "paralysed from overdistension, and unable to rid itself of its burden."

Henry Morris, who considered the excess of secretion to be an important determining cause, suggested the name "gastro-succorrhœa" for this disease. In several cases, however, the distension of the organ is not by any means wholly or even chiefly due to the fluid contents; for when the stomach is emptied of gas by a stomach tube, and before any fluid has escaped, the viscus may return almost to its normal size. Campbell Thomson writes:

"It is, of course, a difficult matter to establish precisely the relationship which exists between the distension and the secretion, but it seems probable that they must be looked upon as two distinct processes.

"The most likely explanation seems to be that the stomach wall becomes paralysed—the possible causes of which will be discussed further on—and then, later on, the organ becomes distended by gas or excessive secretion. Moreover, the fact that excessive secretion is not present in every case makes it impossible to consider it as the primary cause; in some cases there is very little fluid found after death, the stomach being almost entirely distended with gas."

Pepper and Stengel suggest that the immediate cause of the dilatation is a spasm of the pylorus; but if this were so, the not infrequent implication of the duodenum would be still to explain. Wiesinger considers that there is a volvulus of the stomach, and that the distension is similar to that found in a twisted sigmoid flexure.

Albrecht was the first to suggest that the constricting agent is the superior mesenteric artery, which, owing to the downward dragging of the intestines, presses upon and obstructs the third portion of the duodenum. Kundrat, Ewart, and others have offered evidence in support of this view, and there is little doubt that in some cases, at least, the explanation is satisfactory. Albrecht points out that if the descending portion of the duodenum be opened and the finger passed onwards into the transverse portion, and with the other hand traction be

made upon the mesentery by pulling the intestines towards the pelvis, the constricting power of the superior mesenteric artery will be clearly recognised. In Jessop's case, and in others, the distended duodenum was abruptly narrowed at or near the point of crossing of the artery; but in other cases, and these form a majority, there was no constant point at which the stricture was found.

The view which seems to be most highly favoured by the majority of writers is that the paralysis of the muscular wall of the stomach is primary. Carrion and Hallon ("Sémaine Médicale," August 21, 1895) have shown that the section of the pneumogastric nerves in the dog leads to dilatation of the stomach, and to symptoms resembling in many cases those of uræmia. It is clear that in some instances, as soon as the stomach has reached a certain size, it is almost impossible for it to recover, either because there is some kinking or rotation at the pylorus, or because pressure is exerted, as Box and Wallace suggest, upon that part of the duodenum which crosses the third and ascends by the side of the second lumbar vertebra in the left side.

Attention has been specially drawn by P. Müller ("Deut. Zeit. f. Chir.," August, 1900) to dilatation of the stomach following upon abdominal operations. In some of these cases the gastric distension is only a part of a general involvement of the intestinal canal, due to peritonitis. The septic condition induces a paresis of the bowel walls, and distension of the gut rapidly follows. In other cases, and it is these to which Müller draws particular attention, the dilatation of the stomach is due to the pressure upon the duodenum of the superior mesenteric artery. When a large ovarian tumour or a fibroid tumour of the uterus is removed, the intestines, compressed for many months or years to the upper part of the abdomen, sink down into the pelvis, and so drag upon the superior mesenteric artery as to compress the duodenum in the manner already described.

Treatment.—Treatment should be directed early to the relief

of this condition. Indeed, if the case progresses far without recognition, the issue is almost inevitably fatal. Recourse must be had at once to the stomach tube, and the viscus must be emptied and washed out with an abundance of hot sterile salt solution. If, as is likely, the stomach begins quickly to refill, the tube must be again passed, and if necessary be left in for several hours.

In my own few cases, relief has always been given by changing the position of the patient. He must be placed prone in bed, with a pillow beneath the pelvis. One acts upon the supposition that there is compression of the duodenum by mechanical traction upon the superior mesenteric vessels. Whether the hypothesis be right or wrong, relief is undoubtedly afforded, sometimes in a most remarkable manner, by the change of posture. In the severer instances opening and drainage of the stomach may be necessary; or the operation of gastro-enterostomy may be considered. Though this measure has never been put to the proof, on theoretical grounds it would appear likely to be of service.

Phlebitis and Thrombosis.—The occurrence of thrombosis of veins is not very infrequent after any form of abdominal operation. It follows most commonly upon pelvic operations, especially abdominal hysterectomy, but also after operations involving the upper part of the abdomen, such as gastro-enterostomy or cholecystotomy.

The thrombosis of the vein may be due to or may precede phlebitis. If thrombosis is the primary condition, which is probably very unusual, it is attributed to heart weakness, and consequent slowness of the blood current, impoverished condition of the blood as a result of long illness, or repeated hæmorrhages (the "marasmic thrombosis" of Billroth), and to an increase in the coagulability of the blood due to an excess of calcium salts.

In the very great majority of the cases, however, it is probable that phlebitis occurs first, and that the formation of a thrombus is secondary. The phlebitis is due, almost certainly, to in-

fection, though many of the recorded examples occurred when it is said that the wound remained aseptic.

This complicaton is found most frequently after abdominal hysterectomy (30 per cent. of the cases). This is an operation in which there are many ligatures left behind, a septic cavity is opened, and no drainage is provided. During an interval operation for appendicitis, there may be disturbance of those veins in the mesoappendix in which clots have already formed in the earlier stages of the disease. We know now that many of the wounds which run an "aseptic" course really contain organisms throughout the time of their healing. Infection, therefore, as a cause of phlebitis, cannot be excluded. To me it is the most likely explanation in all cases, though I quite recognise that a contrary opinion to this is held by surgeons of considerable authority, such as Maurice Richardson and others.

The veins most frequently affected are the saphenous and femoral of the left side. The enormous preponderance of the cases on the left side has never been adequately explained. Dr. W. W. Keen suggested that the passage of the left common iliac vein under the right common iliac artery might lead to a retardation of the blood in the left vein, and thus act as a cause of venous thrombosis. This anatomical arrangement doubtless plays some part in the causation of the condition, and it is well to note also that when there is any congenital anomaly in the venous system below the diaphragm, it is almost invariably found upon the left side. Varicose veins of the lower extremity are far more frequent upon the left side than the right. But it is doubtful whether the merely mechanical conditions which can be brought about by any of the circumstances mentioned would suffice to determine the so frequent incidence of the inflammation upon the left side.

We may summarise the main facts with regard to thrombosis following abdominal operations in this way: Thrombosis occurs most frequently after operations upon the lower part of the abdomen; it is estimated to happen in 2 per cent. of all cases; it is first

noticed about two weeks after the operation; it is more apt to afflict patients who are debilitated by long illness, or whose condition is poor as a result of frequent hæmorrhages; it is found in great preponderance upon the left side, where it affects the saphenous and femoral veins; as a causative factor sepsis can rarely be excluded; phlebitis precedes the thrombosis, as a rule.

Cordier ("Journal of the American Medical Association," vol. ii, 1905, p. 1792) has collected records of 232 cases. He gives the following table, which shews the number of cases following various operations:

Nephrorrhaphy	9
Appendicitis, mostly so-called aseptic cases	27
Cholecystotomy	4
Oöphorectomy (cystic, cirrhotic, etc.)	16
Hysterectomy fibroids, so-called aseptic cases	69
Vaginal operations, character not stated	8
Alexander's operation	3
Hernia	4
Pyosalpinx	7
Pelvic operations, not specified	9
Abdominal and pelvic, character not stated	56
Ectopic pregnancy	4
Vaginal hysterectomy for cancer	9
Suspension of uterus	7
Splenectomy	1

SPECIAL FEATURES.

In 213 cases, left saphenous or femoral veins were affected.
In 8 cases, both left and right veins were affected.
In 11 cases, right veins alone were affected.
In 182 cases, proximal part of vein first affected.
In 36 cases, distal part of vein first affected.
In 14 cases, portion of vein affected not mentioned.
In 166 cases, sepsis was not present at time of the operation.
In 56 cases, no mention of sepsis or asepsis was made.
In 10 cases, there was pus present at time of operation. In the great majority of cases the first symptoms appeared from the 10th to the 15th day.
In 6 cases, pleuritic and lung complications.
In 3 cases, sudden death occurred.

Cordier gives a good description of the clinical course. He writes:

"The usual onset of this condition is marked by a gradually increasing pain along some portion of the long saphenous vein,

usually the left, and most frequently just below the saphenous opening in the fascia lata. This pain may extend along the whole course of the vein and, as a rule, does follow the vessel below the knee. An elevation of temperature of from 2 to 3 degrees is noticed and a proportionately increased pulse-rate is also observed. The pain in limb is increased by moving the limb or by permitting it to remain in a dependent position, and is partially relieved by elevating the leg and thigh. On examining, in many cases, there will be noticed a redness along the course of the inflamed vein or veins. If seen early, no perceptible swelling of the limb will be noticed, but within a few days, if the case is a severe one, the whole limb will be swollen, but more particularly the calf of the leg. This swelling is uniform, and free from discolorations or redness; in fact, the surface is blanched. Pressure along the course of the vein elicits tenderness, and in the calf of the leg the tenderness is found all over the posterior surface. The vein is hardened and rolls under the fingers like a tendon, in many cases. Pressure, if continued for several minutes, may produce pitting, but not so well marked as in the dropsical affections. Except along the course of the superficial portion of the vein, which may feel unnaturally warm, there is a death-like temperature of the surface to the examining hand."

As soon as the condition is discovered it must be treated very seriously, and the patient warned of the risks of disturbance of the limb.

The affected limb should be elevated on a couple of pillows, and some warm and comforting dressing applied. Lead and opium lotion, or warm boracic fomentations, are soothing and grateful to the patient, but they must be applied without disturbing the limb. If a long many-tailed bandage is placed from the buttock to the heel, the front and sides of the limb can be exposed, and the fomentations applied to them without moving the leg. Flannel bags loosely filled with bran, and made hot in the oven, keep warm for a couple of hours; they may be laid over a thin wrap of gamgee tissue and changed as often as necessary, without any disturbance.

Local treatment must be continued so long as there is tenderness in the course of the vein, and the first movements must be made with great gentleness and caution. It is not possible to fix arbitrarily any time for the commencement of movements, but in most cases four or six weeks must be allowed to elapse from the time when the last extension of inflammation occurred, before movement is permitted.

Lennander suggested some years ago that, in cases where thrombosis of the veins was feared, the patient should be kept in the Trendelenburg position for a few days. It is certainly an advantage in some cases slightly to elevate the foot of the bed, and to instruct the nurse to gently rub the patient's legs from the heel upwards for a few minutes two or three times daily.

Stasis and sepsis, probably the twin causes of phlebitis, are both preventable. The latter is perhaps not under our control so completely as we think, but the former can always be counteracted. In some six or seven cases of phlebitis following suppurative appendicitis I have used the intravenous injections of collargol with a degree of success which will urge me to use it in like cases in the future.

The possibility of detachment of a part or the whole of the thrombus must never be forgotten or minimised. Sudden death has occurred upon the patient first attempting to stand, or to move in his chair, as a result of pulmonary embolism.

The question of the association of thrombosis with post-operative pneumonia and pleurisy is discussed elsewhere.

CHAPTER IV.

ABDOMINAL INCISIONS.

I DO not think that, though much thereon has been written, it is yet adequately recognised that the steps in the making and in the repair of an abdominal wound are of the very greatest importance. I doubt whether it is any exaggeration to say that the circumstances connected with the incision are among the most important in the whole range of abdominal surgery. For, if the incision be improperly made, by the free division of muscular fibres or the wilful and unnecessary severing of nerve-trunks, a weakened area is left in the belly-wall the results of which may be of even greater severity than those conditions which first made the operation advisable. Too great care cannot therefore be exercised in the proper choice of a method of incision and of the means of its securest closure. It is a cardinal rule that there shall be no division of muscular fibres unless it is absolutely necessary for a sufficient exposure of the operation field; muscular fibres are always to be separated, never to be cut. Nerves, likewise, are things to be treated with respect, and in many cases a little tact in the arrangement of a wound will result in the avoidance of any injury to them. As an example of the damage that may result from nerve division, I may quote the case of a patient upon whom an abdominal nephrectomy had been performed through the right linea semilunaris; several nerves had been divided, and, as an inevitable consequence, the rectus muscle supplied by them had wasted to the point of almost complete disappearance. An enormous hernia had developed, which no operation could possibly cure. In some instances

when the fibres of the rectus have been split in the performance of cholecystotomy or gastro-enterostomy, without reference to the position of the nerves, that part of the muscle to the inner side of the incision has undergone atrophy, and a hernia has consequently developed. At Czerny's instance Assmy investigated the after-results of cases in which a wide vertical splitting of the rectus fibres had been performed, and shewed that an atrophy of that part of the muscle dissociated from its nerve supply always followed. In cases of gastro-enterostomy, therefore, and in the operation of gastrostomy as performed by Hartmann and Kocher, the rectus muscle is not split at all. The anterior sheath is divided, the whole of the muscle is pulled to the outer side, and an incision is then made through the posterior sheath, on a line directly behind the skin incision. When the operation is completed, the muscle falls back into its normal position.

The splitting of muscular fibres is readily and safely accomplished in the operation of gastrostomy, as was first shewn by Howse; in the operation of removal of the appendix, as was shewn by McBurney; in the operation of removal of the kidney, as was shewn by Edwards, and later by Abbé; in the operation of left inguinal colotomy, and so forth. If, in any incision, a division of fibres can be effected in only a part of the wound, it is to that extent an advantage over an extended division of the fibres.

The principles which guide the surgeon in the making of incisions elsewhere must guide him here also. The cut must be perfectly clean; the edges of the muscle when separated or divided must be sharply defined; there must be no fraying of the edges, due to clumsy or untidy work. Furthermore, any rough handling of the wound during intra-abdominal manipulations must be expressly avoided. If a difficult manipulation is performed through an opening

which cramps the surgeon's hands, the wound edges will be bruised, perhaps soiled with escaping fluids; indeed, so great damage may be done that a proper healing of the wound is impossible. All incisions must, therefore, be of adequate, though never of undue, length, and as soon as the abdomen is opened a protection to the lips of the incision must be afforded by a covering of flat swabs, small linen squares, or other soft material which has been thoroughly sterilised and wrung out of hot sterile salt solution. Wounds heal more kindly the greater the respect with which they are treated. I feel sure that some of the cases in which a stitch abscess seems incapable of explanation may be accounted for by the fact of rough handling and bruising of the cut edges of the wound. The method of incising the peritoneum between a clip and a pair of forceps is shewn in figure 12, the slitting up of the peritoneum on the forefinger in figure 13.

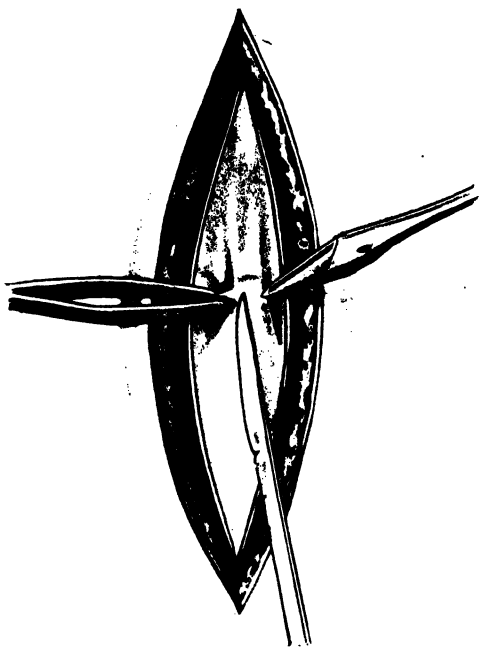


Fig. 12.—Incision of the peritoneum. The clip is held by the assistant, the dissecting forceps by the surgeon.

The special incisions used in each region will be discussed in detail in each section.

In the **suture of incisions** great care is also necessary. When muscular fibres have been separated and pulled forcibly apart, the moment the retractors are withdrawn the fibres come together and close the temporary gap. How strongly

the muscles act in securing the closure of such a wound can be realised if the finger happens to be therein when the patient is straining, vomiting, or coughing. The finger is gripped in a sort of vice. Nevertheless I usually put in one or two sutures, uniting the separated edges, to ensure perfect accuracy of apposition. When a muscle is divided—say, the rectus—or an incision is made in the middle line, the wound should always be stitched up in layers. I generally use three layers of sutures passed in the following manner:

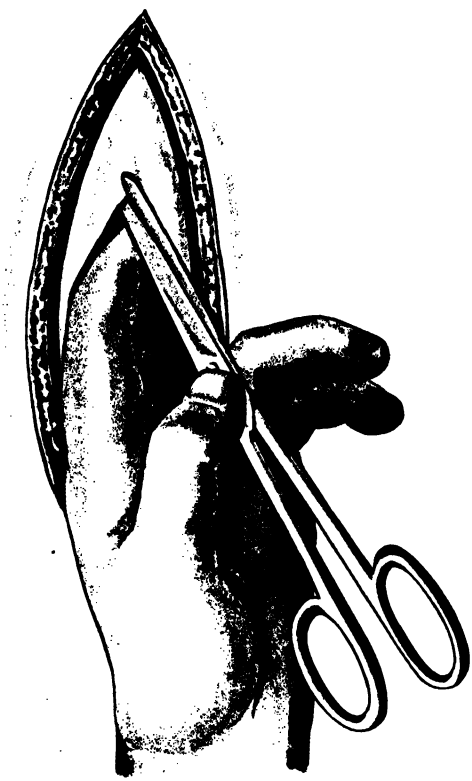


Fig. 13.—Division of the peritoneum.

A Hagedorn needle armed with a long thread of No. 2 catgut is used; the first stitch is taken at the top of the wound, and picks up the peritoneum and the fascia transversalis and the posterior sheath of the rectus, above the umbilicus; this stitch is continuous and extends from the top to the bottom of the wound. The needle is then laid aside, to be presently resumed. A series of silkworm-gut sutures are now passed through all the thickness of the abdominal wall which is not embraced by this first catgut suture; that is to say, that the skin and subcutaneous tissues, the anterior sheath of the rectus, and the bulk of the muscular fibres of the rectus are all included. A series of these stitches are passed, at intervals of about three-fourths of an inch, along

the full extent of the wound. The ends are left loose on each side, and are there seized by a clip. These interrupted silk-worm-gut sutures being introduced, the needle armed with catgut just laid aside is taken up again. The same suture, without knotting or interruption, then returns from the lower end to the upper, picking up the anterior sheath of the rec-



Fig. 14.—Suture of abdominal wall, shewing the continuous suture of catgut.

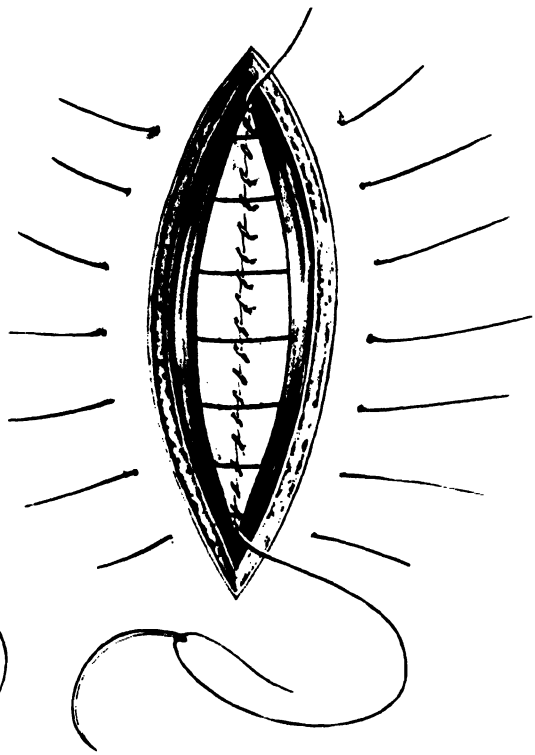


Fig. 15.—The interrupted sutures of silk-worm-gut.

tus and a few of its muscular fibres. This stitch is pulled with sufficient tightness to get a good apposition of the anterior sheath of the rectus. When the upper end of the wound is reached, the end of the stitch is tied with the original end which had been left long, and the ends are cut short. The condition on section is shewn in figure 17.

The interrupted silkworm-gut sutures are now tied and cut short. For the exact apposition of the skin edges I have frequently used Michel's clips.

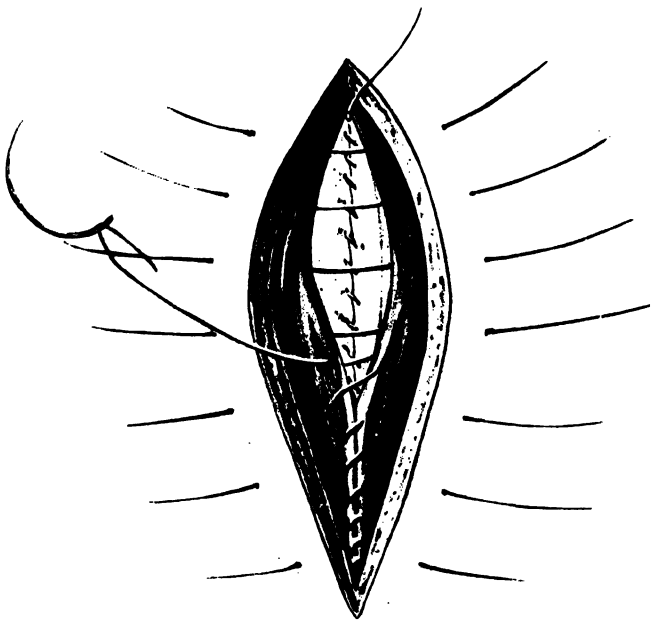


Fig. 16.—Suture of abdominal wall, the continuous suture returning and picking up the anterior sheath of the rectus.

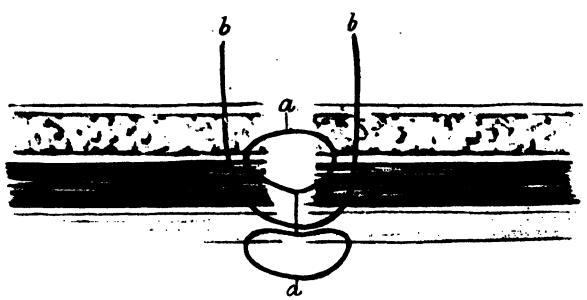


Fig. 17.—Suture of the abdominal wall. Section shewing the position of the stitches: *a* and *a* are the different parts of the same continuous suture; *b*, *b*, interrupted sutures.

In some cases where the abdomen is very lax there may be need of a slight overlapping of the cut edges of the ante-

rior sheath of the rectus. It has been shewn that the greater part of the strength of the scar lies in the anterior sheath of the rectus; if good healing is obtained in that, the cicatrix is not likely to yield. The overlapping adds greater strength, therefore, to the scar. The methods of securing this overlapping are shewn in the figures.

With regard to the material which is used for the buried suture, nothing can be better than medium catgut adequately sterilised. The use of silk for buried stitches, though advocated by Kocher, possesses no single advantage over catgut, and it, questionless, possesses more than one disadvantage. The fallacy which supposes that a non-absorbable suture continues its functions perpetually has been exposed times without number. The wandering of such sutures away from the place of their introduction is a matter of common observation. If, therefore, they cease after a time to perform their necessary functions, they are, for their purpose, less to be commended than sutures which, having achieved their purpose, disappear. The weight, both of argument and experience, is, so far as I can ascertain, entirely on the side of those who use catgut rather than a non-absorbable material for their buried sutures.

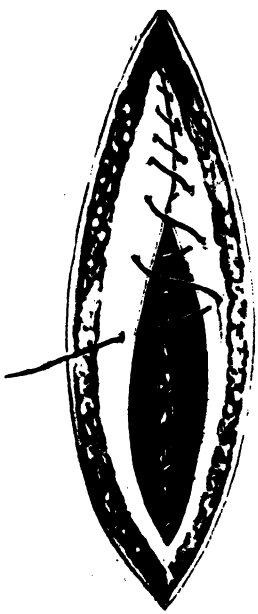


Fig. 18.—The overlapping of the aponeurosis of the rectus in the suture of an abdominal wound (Noble's method).

The method of suture of the wound just described has been found to give perfectly satisfactory results. It possesses the advantage of giving easy and accurate apposition to all the layers of the abdomen, and it especially supports the aponeu-



Fig. 19.—Overlapping of the aponeurosis in closure of abdominal wounds. The method of passing the needle is shewn in the diagrams.

rosis of the rectus, in that through this structure there are sutures of apposition and of wider support.

To obtain clean and perfect healing and permanent strength in the wound, it is necessary, therefore, to have

(*a*) clean-cut, neat incisions,

(*b*) an absence of teasing or fraying of the muscle edges,

(*c*) protection to the lips of the wound from damage by instruments, hands, or discharges,

(*d*) perfect asepsis throughout,

(*e*) accurate suturing in layers, sutures of apposition and sutures of support both being used,

(*f*) an absence of tension in the wound.

CHAPTER V.

PENETRATING WOUNDS OF THE ABDOMEN.

A DISTINCTION has been drawn between penetrating and perforating wounds of the abdomen, but the distinction is, for clinical purposes, negligible, for, in the great majority of instances, complete penetration of the abdominal wall implies also a perforation of some viscus. The wounds in which the greatest damage to viscera is inflicted are generally below the umbilicus.

The viscera are injured in the following order of frequency: the small intestine, the liver, the stomach, the large intestine, the other solid viscera. As soon as the intestine is wounded, if the wound is small, there is a prolapse of the mucous membrane, which temporarily blocks the opening and prevents a discharge of the intestinal contents. It is generally supposed that the leakage of the contents occurs instantly upon the solution of continuity in the bowel, but this is not the case. A temporary sealing is the rule. The two conditions which aid in extravasation are intestinal distension and the manipulations of the surgeon. When the injury is inflicted upon the intestine, the damage is of such a character as to cause a local stunning or paralysis of the bowel; movement is, therefore, arrested, and the pouting of the mucosa temporarily blocks the opening. When distension occurs, and when the power of movement returns, then leakage may occur. Murphy has pointed out forcibly that extravasation occurs chiefly on manipulation. When the solid viscera or the mesentery are wounded, hæmorrhage occurs, often in profuse quantity.

Douglas writes:

"The effects of any given penetrating wound of the abdomen are problematical. Their nature is uncertain; the tract is always septic; the number of perforations, unknown; complications cannot be foretold. If a ball of average velocity enters the abdominal cavity, perforation is to be expected. That it may find its way between the interstices of the intestines we have previously admitted as a possibility; but that it may produce perforations of the intestines from one to twenty-eight in number is a recorded fact; that, if solid viscera lie in its course, it will traverse these and, in all probability, will wound other viscera. Multiple perforations occur most frequently in the ileum, and are oftenest made by bullets that pass through the abdomen obliquely from side to side."

The following is the method of operating: The abdomen is opened through a median incision under all circumstances —lateral incisions must not be used, for some part of the necessary investigation cannot be conducted through them.

The escaping blood-stained discharge is cleared away as speedily and completely as possible, and if there is evidence of hæmorrhage occurring at the moment, the solid viscera, liver, spleen, kidneys, and the mesentery, must be first examined. If injuries thereof be found, they must be dealt with forthwith, for injuries of the hollow viscera are far less urgent in their need for attention.

Wounds in these viscera may be treated by suture, by cauterisation, or by packing with gauze. The liver and the kidney both hold sutures well; the spleen generally tears away under the tension of a stitch. In extensive wounds of either spleen or kidney the organ may have to be excised. The sutures used for the control of the hæmorrhage are passed with an ordinary large intestinal needle, or, in the case of the liver, by Kousnetzoff's special instrument. If the kidney be injured, posterior drainage is needed.

The solid viscera having been dealt with, the intestine

must be methodically examined. Starting from a fixed point,—the duodenojejunal flexure or the cæcum,—the whole of the small intestine is rapidly passed through the fingers, and, as a rent is exposed, it is at once sutured. Two or three rents may lie close together, but if so, it is better to suture them than to excise the damaged length of gut. Resection is at times necessary, but it should be adopted only when simple suture is impossible. As a rule, there is no need to turn the intestines out of the abdomen, but this may be done if necessary.

As the bowel is examined, the mesentery is carefully searched for a wound. If one of small size be found, it may be closed with a single suture. If there be a large one, parallel to the bowel, the segment of gut supplied by the torn vessels will have to be excised. All rents in the intestine are closed by a double layer of sutures in the usual way.

Other organs are now examined—the bladder, large intestine, pancreas, etc.—with equal care. Though a detailed examination of all parts is tedious and time-consuming, it cannot be neglected with impunity. Disaster follows perfunctory work.

Lavage and drainage are adopted in the manner and under the circumstances already described. It is safer always to drain.

The experience of surgeons in America is far greater in this matter than that of any European surgeon. I cannot, therefore, do better than quote from Dr. Douglas's admirable work on "The Surgical Diseases of the Abdomen" the following paragraph on the general surgical indications in cases of gunshot wound of the abdomen:

"The indications in any given case of gunshot wound of the abdomen are to relieve shock, control hæmorrhage, remove infectious matter, re-establish the continuity of the injured viscera, and provide direct or indirect drainage. If the patient is in great pain, a hypodermatic injection of morphin should be immediately given, and he should be moved

with greatest care to his home, or preferably, to a hospital. Preparations should be in progress for an abdominal section. Stimulants may now be indicated. If penetration is not obvious, this question should be determined by enlarging the wound of entrance under cocain anæsthesia. If penetration is found, or if, from the location of the wound, course of the bullet, and the symptoms, it seems at all probable, a general anæsthetic, preferably ether, is administered, and laparotomy at once undertaken. The abdomen is opened through the linea alba preferably, as the track of the bullet is always septic. The location of the wound and known course of the bullet may justify lateral opening. When the peritoneum is opened, if there has been much hæmorrhage, its free escape intensifies the existing shock. To overcome this, the assistant, who has previously exposed a vein and introduced a cannula, now proceeds with the intravenous infusion of normal saline solution, the surgeon having by this time secured the principal bleeding points, which is the first indication on opening the abdomen. If, while searching for these, he meets with intestinal perforations, they should be surrounded with gauze to mark them and to prevent extravasation. The increased vascular tension due to the saline infusion will develop bleeding points which might otherwise escape notice. This known action of the saline prohibits its use until the abdomen is opened and the chief bleeding points are controlled. Our methods of hæmostasis are ligature, suture, actual cautery, and gauze packing. The next step is to repair the injured viscera by the special methods which will be emphasised under their several headings. Unless there has been widespread extravasation of visceral contents, the peritoneal cavity should not be flushed, but all material removed by gentle sponging with gauze. After the intestinal perforations are closed, an ounce of saturated solution of sulphate of magnesium should be introduced through a cannulated needle into a coil of the intestine remote from the wound, and this puncture closed by suture. The question of drainage in gunshot wounds of the abdomen is *sub judice*. Tiffany, Coley, and, indeed, the majority of surgeons, advise drainage in all cases in which viscera are injured. Fenner's personal experience in 6 cases with 5 recoveries and 1 death, all treated without

drainage, and my own experience in 8 cases with 2 deaths, lead me to the conclusion that drainage is not desirable if there is little or no extravasation and if the operation has been done within six hours. In operations after that time and in all cases where the general cavity has been irrigated multiple gauze drains should be employed. The bullet wound in the parietes, either of exit or entrance, should be excised and closed by sutures or left open and drained with a strip of gauze."

Dr. Fenner ("Annals of Surgery," vol. xxxv, p. 15) reports six cases of penetrating wounds of the abdomen treated by operation, and gives statistical tables of 152 cases treated at the Charity Hospital, New Orleans, between January, 1892, and January, 1901. There were 96 cases of gunshot wound of the abdomen with visceral injury. Of these, 71 died—a mortality equivalent to 73.95 per cent.

This subject is discussed further in the chapters dealing with the injuries of the several viscera.

CHAPTER VI.

THE SURGICAL TREATMENT OF ACUTE PERITONITIS.

CASES of acute peritonitis may be classified into three groups:

1. Those in which the inflammation is localised, and an abscess, definitely and sharply separated from the rest of the peritoneum, is present.
2. Those in which the peritonitis is spreading away from the original source of infection, but in which some part of the peritoneum is demonstrably healthy.
3. Those in which the affection of the peritoneum is universal.

The following remarks apply to the last group. The principles of treatment in the first and second groups are dealt with elsewhere.

OPERATION IN ACUTE PERITONITIS.

In cases of acute general peritonitis operation is indicated, *firstly*, for the purpose of giving vent to the products of inflammation—pus, sero-pus and the escaped contents of wounded viscera; *secondly*, for the purpose of removing, or of otherwise dealing with, that organ or viscus from which the inflammation originally started; *thirdly*, for the purpose of cleansing, so far as is possible, the walls and recesses of the infected cavity; *fourthly*, for the purpose of emptying, and if need be draining, the intestine whenever it is paralysed in over-distension; and, *fifthly*, for the purpose of providing for a further discharge by free drainage (which can only be of a temporary character), or for shutting off by gauze packing the most infected part of the cavity. I do not think that in any abdominal operations ever undertaken by the surgeon the need for speed, com-

bined with aptness, can be greater than in these. Slow operations mean death from shock; imperfect operations mean death from a continuance of the acute inflammation. Perfunctory work and slow work are both out of place.

It must be the surgeon's duty, therefore, to ensure that every precaution is taken to lessen or avoid the incidence of shock, and to see that absolutely everything needed in the operation is ready before the anæsthetic is administered.

As a rule, an enema of 10 or 12 ounces of warm water with an ounce of brandy and a hypodermic injection of 10 minims of liquor strychninæ will be given. The cleansing of the abdomen can generally be done before the ether is given. The abdomen is opened by a free incision in the middle line. As soon as the peritoneum is incised, the character of the escaping fluid is noticed. The fluid in the case of perforated gastric ulcer is generally turbid, abundant, and flakes of lymph or of food are floating in it. When the duodenum is perforated, the fluid may be bile-stained. In both, the gas, which is also present free in the peritoneal cavity, is odourless; this is a point of considerable diagnostic importance, for if the gas be of strong odour, perforation in the stomach or duodenum can almost certainly be excluded. If the fluid be darkish brown and offensive, a low perforation of the intestine will be suspected. In cases of typhoid fever in which an ulcer perforates the fluid is turbid, contains brownish material and particles of curdled milk or other food. The characters of the fluid are not always such as to give help to the surgeon. Pus may result from a variety of conditions, and its abominable offensiveness, though suggesting a perforation of the appendix more decidedly than any other lesion, is not pathognomonic.

The hand or three fingers are now introduced within the abdomen with the most scrupulous gentleness and care. The damage done by clumsiness now may be irreparable; the rough and forcible pushing of the hand indiscriminately within

the abdomen may rupture the thin and tender peritoneum tightly stretched over an inflamed intestine, and leakage of highly infective organisms through these rents may produce a fatal inflammation.

The search within the abdomen is purposeful. The cæcum is first sought, in order to ascertain the condition of the appendix, and in order to discover the condition, as to distension, of the cæcum itself. If the appendix be discovered to be gangrenous, it is dealt with at once in the usual manner. If the cæcum is found distended, it is clear that the lesion, if of an obstructive character, is in the large intestine. The sigmoid is then sought; if that too is distended, the condition (if the rectum be unobstructed, which, presumably, it is known by previous experience to be) is one of general paralytic distension of the intestine due to a universal inflammation. If a search has so far proved ineffective and the condition of the patient permits a further investigation, a close scrutiny should be made in order to discover any thick localised deposit of lymph. This, in the majority of instances, will lead to the discovery of the source of offence, for the first and instant response of the peritoneum to injury is the abundant outpouring of lymph and fluid. If it be noticed that though fluid is everywhere present a thick, "wash-leathery" deposit of lymph is confined to one area alone, in that area the perforation or other source of irritation may confidently be sought.

The primary disease having been discovered and having been dealt with as seems best, the question next arises as to the surest means of cleansing the peritoneal cavity. With regard to this matter there are still widely divergent opinions among surgeons of great experience. Some advocate the free universal flushing of the peritoneum; others are convinced that this is largely a measure of harm, and are content with gentle sponging, while still others rely solely upon the insertion of drains of rubber tubing or of gauze.

My own practice is at once to make a second incision in what seems the most appropriate place for affording free drainage—in the case of the appendix, the incision is made over the iliac fossa. Through this incision a piece of large rubber tubing attached to a funnel is introduced, and a free irrigation of hot sterile salt solution is begun. If both renal pouches are affected and a copious deposit of pus is found in them, incisions are made into them from above the iliac crest. Incision and drainage in these places may serve to prevent a subphrenic abscess. I frequently make three, and occasionally even five, incisions into the abdomen, each large enough to take a split rubber tube or a dressed tube. It is impossible to drain the whole peritoneal cavity through a simple opening—the difficulty, indeed, is to drain it adequately through many openings. Such drainage is only temporary, owing to the rapid encapsulation of the tube or gauze. None the less it is of supreme advantage and importance.

It is constantly said that the lavage of the peritoneal cavity is largely futile because the recesses and complexities of the peritoneum are such that no flushing, however carefully executed, can possibly clean out all the collections. I am disposed to doubt the accuracy of these observations. With a supple rubber tube of good diameter, a free flow of saline solution, and easy means of escape by tubes introduced into other incisions, a reasonably complete cleansing is certainly possible.

It is the practice of many surgeons to leave as much fluid as possible in the peritoneal cavity. Whether much or little is left seems a matter of indifference, for if much be left, there is probably an easy escape for it within a very short time through the various incisions, each holding its own drainage-tube. As a rule, I mop gently any specially infected part of the abdomen and empty away all excess of fluid. A rubbing of the peritoneum, when gauze swabs are introduced for mopping purposes, is to be expressly avoided, for this rough

friction probably does more hurt to the peritoneum than anything else.

As a rule, only the original incision needs to be sutured; the other openings are purposely made of a size no larger than is necessary for the easy introduction of the drainage-tube.

The making of the multiple incisions in this manner does not in the least weaken the abdominal wall, for the surgeon is careful to split through the muscles everywhere, and not to cut them rashly; and is careful, also, to avoid the section of nerves.

There are many surgeons of ripe experience who advise that in order to secure more complete cleansing of the peritoneum the whole intestine should be brought outside the incision, or at least well into the wound, loop by loop, and thoroughly cleansed by washing or wiping "with considerable force" the entire surface of bowel and mesentery. I have never carried out this advice, and I cannot think that it is one likely to advance the patient's chances of survival. It is a little too heroic.

A further point to be considered in all these desperate cases, when distension, even to paralysis of the gut, is present, has reference to the need for evacuating the contents of the intestine by enterotomy or enterostomy. There can be no question that in many cases a free evacuation of the stagnant gas and fæcal material is entirely an advantage. The intestines are little likely to regain their power of contraction when distension has passed beyond a certain point, and when this power returns, there seems to be a return also of the rapidity of absorption of the intestinal contents. These are of an intensely toxic character, as we know by abundant painful experience and by the experiments of Kader. The emptying of the intestine should, therefore, be considered an almost routine practice. If carried out in the manner described elsewhere, with the help of a glass tube inserted into the bowel, upon which the gut is drawn, the emptying of the intestines is a simple, speedy, and satisfactory matter. The opening,

of course, is made as low down in the intestine as possible. Lennander makes two or three openings in the intestines at various levels, establishing at each a "Witzel fistula." The lowest of these fistulæ leads into the cæcum, and is used, if need be, for administering liquid food by the colon.

Dr. Andrew McCosh has suggested—and I have frequently acted upon this important suggestion—that a large dose of sulphate of magnesia should be introduced into the intestine, high up, for the purpose of ensuring a return of peristalsis. Dr. McCosh (Intern. Soc. of Surgery, Sept., 1905) wrote: "Though I still employ this method I am less enthusiastic as to its value. Some surgeons, however, regard it with favour and I am still inclined to believe that it is often beneficial. If the source of the peritonitis has not been removed it of course should never be employed."

As soon as the patient returns to bed, he is propped up almost in the sitting posture. This is far more comfortable for him, allows drainage down towards the pelvis, and away from the diaphragm, and thereby lessens the risks of that most serious complication, subphrenic abscess.

Warmth should be freely applied to the patient; rubber bottles filled with hot water and swathed in flannel should be placed close to the body and extremities. Care is, of course, taken to ensure that the patient is not burnt by these. In many cases, especially if vomiting has been a troublesome and persistent symptom, the stomach must be washed out before the patient leaves the operating-table, and, if necessary, an ounce or two of hot water, in which some Rochelle salts or sulphate of magnesia is dissolved, is allowed to remain in the stomach. If vomiting persists after the operation, the stomach may again be washed out, with great relief to the patient.

If collapse occurs or deepens, the infusion of about 1½ to 2 pints of saline solution into the median basilic or other accessible vein will help the patient to rally. This may be repeated at the end of twelve to twenty-four hours if necessary.

Recently I have used, with striking success in several cases, the method, introduced by Kocher, of continuous subcutaneous infusion. Two needles connected by india-rubber tubes and a Y tube, with a funnel, are introduced into the subcutaneous tissue, one into each thigh or one into each axilla. Normal saline solution is poured into the funnel and drains slowly into the tissue. About one pint in an hour is the best quantity to introduce. Care must be taken to keep the fluid at the proper temperature (about 105° F. in the funnel). To the first pint of the saline solution (0.9 per cent.) may be added 2 to 8 per cent. of glucose and ½ to 2 per cent. pure alcohol; subsequently, saline solution only is given.

The bowels should be encouraged to act as soon as possible by the administration of turpentine enemata or by the injection of glycerine.

Hypodermic injections of strychnine, say 5 minims every four hours, can often be given with advantage.

It is worthy of note that the method above described does not meet with universal sanction. There are surgeons who do not use the method of flushing the peritoneal cavity, being content with incision and drainage; and there are others who follow Dr. Joseph Blake, of New York, in his practice of free irrigation of the peritoneum without drainage.

Dr. Blake writes: "I was formerly a warm advocate of abundant drainage; later I became convinced of the utter impossibility of draining every part of the peritoneal cavity, for it was evident that the drains were soon isolated by adhesions, so I next confined myself to the drainage of the field of operation, and then, perceiving that the other similarly affected regions of the peritoneum took care of themselves, I omitted drainage almost entirely and only employed it when the presence of necrotic tissues or hæmorrhage demanded it."

My own practice in these cases is to ensure, as far as possible, cleansing by free lavage, free drainage, and, if need be, emptying of the intestine by enterotomy or enterostomy.

CHAPTER VII.

TUBERCULOUS PERITONITIS.

THREE forms of tuberculous peritonitis are recognised:

1. The ascitic form.
2. The fibrous form.
3. The suppurative (ulcerative) form.

It is of the first importance from the surgical point of view to bear constantly in mind the fact that the various forms of tuberculous peritonitis are *secondary*, and not *primary*, diseases. The invasion of the peritoneum occurs from some organ within the abdomen which itself has been attacked by a tuberculous process. Just as acute septic peritonitis is due to the spread of infection from some organ which has been first attacked (the appendix, for example), so in tuberculous peritonitis the peritoneal invasion starts out from some organ which has been primarily affected by the disease. The importance of this knowledge of the secondary character of the tuberculous process in the peritoneum, so far as concerns treatment, cannot well be exaggerated.

1. In the ascitic form the peritoneal cavity is filled with a clear serous effusion. The peritoneum, both parietal and visceral, is covered with small nodules, which are placed as close together as is possible. Wherever one looks or feels it is the same,—the peritoneum is thickly studded with fine rough granules. A piece of intestine, allowed to escape from the wound, shews a peritoneal surface that has lost all its smoothness and polish. The surface is rough, congested, red, and thickened. If carelessly handled, it is apt to bleed, or some of the outer coat may slither away beneath the finger. The fluid is free in the peritoneum, there are no loculi, and there are no adhesions, as a rule.

In a certain number of cases the deposit of tubercles may be so thick that a definite, palpable tumor may be formed. Thus the omentum may be an inch or even more in thickness, and it may be shortened and puckered upwards to the greater curvature of the stomach. The primary source of infection, a Fallopian tube, the appendix, and ulcer in the intestine, or a mesenteric gland, may be recognised or may be securely walled off in a mass of protective adhesions.

2. The fibrous form is comparatively rare. It is due to a similar deposit of tubercles to that already described, but there is a complete absence of serous effusion. The opposing peritoneal surfaces have everywhere become adherent, until, at the last, there is no peritoneal cavity left. However extensively adhesions are separated, adhesions still are met with. It is quite exceptional to find even a few drops of serous effusion.

In certain rare instances a combination of the conditions described above may be found. There is a localised cystic swelling whose walls consist solely of fibrous tissue, with a deposit of tubercles universally distributed, separating the fluid from the intestines which lie immediately outside. The peritoneal cavity elsewhere is obliterated by adhesions, and tubercles may be seen scattered everywhere. I have recently operated upon such a case,—a cystic tumour without pedicle enucleated from a bed formed by the intestines, which, in other parts, were so adherent that separation was impossible. Cystic swellings may develop in the pelvis of women and form tumors resembling ovarian cysts. Their walls are fibrous and thick, and into their cavity the patulous end of a tuberculous Fallopian tube will be found to open.

3. The suppurative form is found in those cases in which the tubercles, deposited in the peritoneum, have undergone caseation. As the result of a mixed infection, suppuration occurs. In such circumstances it is constantly found that the pus becomes localised. A general distension of the peritoneal cavity with pus is rare; the rule is to find one or more loculi completely separate one from another, each containing fluid. In all, the fluid may be

purulent, or pus may be found in one, and clear or turbid fluid in another. The visceral walls bounding an abscess cavity are often attenuated, even to such a degree that the gentlest handling may result in rupture. This form of the disease is more common in children.

The question as to the advisability or necessity for surgical treatment has excited great interest and frequent discussion. The opinion of surgeons is now almost unanimously in favour of operation in the ascitic form of the disease, and against operation in both the fibrous and the ulcerous forms. In the ascitic form the results, both immediate and remote, are good; the immediate results are, indeed, very often surprising. The patient almost at once makes haste to improve; he eats better, puts on weight, and his appearance improves almost beyond recognition. The permanent results are, perhaps, not quite so remarkable. After a period of the brightest health, the patient's vitality may flag; other deposits than that in the peritoneum may take on a great activity, and patches of disease in the lungs, or pleura, or the generative organs, may grow apace. This is especially the case when the primary source of the disease has been allowed to remain. If the abdomen has been merely opened, emptied of fluid, and closed, the primary source of infection, the Fallopian tube or the appendix, may continue to pour out its supply of active bacilli into the peritoneal cavity as it did before. The effusion reappears, and a second, or a third, or a fourth operation may be necessary. When, however, the primary disease has been removed, the results are very much more satisfactory. "Recurrence," so called, of tuberculous peritonitis, means continued infection.

Before reckoning up the advantages of surgical treatment in this disease it is necessary to recall the fact that tuberculous disease of the peritoneum tends not rarely to spontaneous recovery. Patients may remain ill from the disease for months, but under careful nursing, with generous but prudent feeding and a plentiful supply of fresh air, they may slowly return to

health. Borchgrevink comes to the conclusion that approximately one-third of all cases recover spontaneously or under careful medical treatment. This estimate is probably in excess of the truth, and it does not take into account the cases in which, after months or even years of apparent relief, the tuberculous process spreads to other parts and, by its increase, causes death.

The results of surgical treatment have been studied by many writers. Rörsch, writing in 1895, gave the result of his examination into the histories of 358 cases. Thirty-two patients died as a result of the operation; 51 patients died within eighteen months as a result of a recurrence of this disease, or of an extension of disease in areas affected before the operation was undertaken. The remaining 275 cases all shewed improvement; in 63 of these, over two years had elapsed from the time of the operation, and all these patients were in good health and free from obvious disease.

Wunderlich, in a series of 344 cases, found that 81 patients died as the result of the operation. Of the remainder, 80 patients had remianed well for over three years.

Margaracci reported 250 cases of laparotomy in Italy with 85 per cent. of recoveries; Adossides, 405 operations with 75 per cent. of recoveries.

These lists undoubtedly include cases all of which were not suitable for operation. If those patients suffering from the ascitic form are alone treated by operation, the results will shew a permanently good result in at least 50 to 60 per cent. of cases. In Czerny's clinic 40 to 50 per cent. of cures are reported, and in recent years these results have been surpassed.

Operations performed upon patients affected by the fibrous form of disease are rarely productive of any good result, and some harm may undoubtedly be done by the attempted separation of adherent coils of bowel.

In such cases, the intestine may be wounded when the abdominal incision is made, for there may be a firm agglutination between the bowel and the parietal peritoneum.

In a few instances circumscribed pseudocysts may form between the adherent coils of intestine; often small, they may at times increase in size rapidly and come at the last to form cysts having a capacity of several pints. Such cysts have no walls other than the walls of the bowel around them; their removal is then impossible. When opened, they should be emptied, wiped out carefully, and not drained. As Murphy points out, these cyst-cavities are easily infected, and once infected they continue as suppurating sinuses for months.

The suppurative form of the disease is often secondary to a suppurative disease in the Fallopian tube or in the intestine. When treated by operation, the results are sometimes disastrous, for fæcal fistula may be caused by the gentlest handling of the bowel, or the gut, already weakened by disease, may burst, either at once or in a few days, into the abscess cavity after the pus has been allowed to escape.

There are cases, however, of localised suppuration which are rightly treated by operation. They are the cases in which a circumscribed cyst formation, as previously described, has occurred, and the suppuration is due to a mixed infection. These cysts should be opened, gently cleansed, mopped out with weak formalin solution, and closed. Murphy relates an extreme case of this kind. He writes: "In one of my cases there were no intestines except the descending colon and the rectum below the umbilicus, a firm diaphragm of adhesions having formed across the abdomen at the umbilical level. The peritoneum above this diaphragm was free from tuberculosis; below the diaphragm was one large empyema of the peritoneum. After opening and draining the cavity, this wall proved so dense and firm that there was very little contraction and the patient succumbed to the toxæmia of the mixed infection. The abdomen should have been closed after the exploration and repeatedly aspired and injected with a solution of formalin-iodoform-glycerin."

To sum up: Surgical measures should be adopted only in

those cases of tuberculous peritonitis in which there is effusion of fluid into the general peritoneal cavity. In these cases a decided benefit results from the operation; the immedate effect is often remarkably good, and the number of cases in which a permanently satisfactory result is obtained is probably 50 per cent. of the whole. The fibrous and the suppurative forms of peritonitis are rarely suited to treatment by operation; operation in most of these cases almost certainly does harm rather than good.

It is certainly desirable that operation should be practised in an early stage of the disease, or at least should not be postponed until the patient has become so wasted and exhausted that the shock of the operation is likely to be serious. After a trial of general medical treatment for three to six months after the onset of a fluid effusion, surgical measures should certainly be advocated.

OPERATION.

The operative treatment of tuberculous peritonitis is due to Spencer Wells who, in 1862, opened the abdomen of a patient whom he supposed to be suffering from an ovarian cyst. Tuberculous peritonitis was found and the abdomen was closed. To everyone's surprise the patient rapidly improved after operation, and was soon cured of her disease. The first formal advocacy of laparotomy as a therapeutic measure is, however, due to König, in 1884.

The surgical indications in dealing with tuberculous peritonitis by operation are, as stated by Murphy:

1. To remove or shut off the source of supply of the tuberculous material; that is, to remove the primary focus of the disease.
2. To remove the products of the infective process from the peritoneum.
3. To increase the tissue proliferation for the encapsulation of the foci already present.
4. To avoid mixed infection.

The operation in the ascitic form of the disease is of the simplest character: The abdomen is opened in the middle line below the umbilicus, an incision of about four inches being made. Care is necessary when the parietal peritoneum is being incised, for the membrane is often greatly thickened, and a coil of intestine may chance to be adherent to its under surface. As soon as the peritoneum is incised, some fluid will escape. The fluid should be emptied as completely as possible; as soon as the flow from the wound has ceased, the edges of the incision are held apart and a sterile gauze swab is passed into the pelvis and into the kidney pouches, so as to mop up any fluid that lies there. In doing this all rough manipulation must be avoided; the peritoneum must be gently patted with the swab, and not rubbed by it. Friction will only start a slight but troublesome bleeding from many points.

In these manipulations it may become evident that the origin of the disease lies in some special portion of the abdominal contents in the Fallopian tube, intestine or appendix. If the surgeon feels assured of this, he should not hesitate to remove the source of offence, for a complete healing of the disease is then more likely to result. Resection of a diseased part of the intestine or short-circuiting may therefore be necessary. If the patient is a woman, it is well to place her in the Trendelenburg position as soon as the fluid is emptied away. A free examination of the pelvic organs is then possible, and an affected tube or tubes can be at once removed. In cases of the ascitic form of the disease an operation should not be considered complete which leaves unexamined any of those areas which are known to be commonly the primary sources of infection. In women undoubtedly the peritoneal inflammation is secondary to tubal disease in a very large number of cases, and in all such the affected tube must be removed. The very significant patulous condition of the fimbriated opening of the Fallopian tube should always be remembered. As Murphy has shewn, it indicates invariably the presence of tuberculous disease within

the tube. The exposure of the tube and its removal may be extremely difficult. The adhesions are so complex, the adherent bowel so thin and friable, that the utmost care is needed in detaching the tube. It may be that the anatomical landmarks are obliterated in a bewildering mesh of adhesions. The round ligament must then be sought at the internal abdominal ring and traced backwards to the uterus. Little by little, adhesions are separated with the utmost gentleness, until the tube is well exposed.

The cavity being rendered as dry as possible, the abdominal wound is closed by suture in the usual manner. Drainage should not be practised,—it is of no advantage, and it is not unlikely to do harm by causing adhesion of the drainage material to a piece of bowel which may subsequently give way.

Some surgeons advocate the introduction into the abdomen of iodoform; others, the washing out of the peritoneal cavity; others again, drainage through the vagina in the female. All these are unnecessary. Simple opening, emptying and closing of the abdomen, with removal of the primary focus, are all that are necessary to ensure success; and, throughout, the utmost gentleness is needed.

The reason for the success of simple evacuation of the fluid is not quite clear. On the whole, the explanation given by Gatti seems the most reasonable. He believes that the fluid poured out by the peritoneum after closure of the wound, like the fluid found in the general peritonium when a localised appendicitis is present, is actively bactericidal, and that it exerts a potent deleterious influence upon the tubercle bacillus. It is certain that in many cases, probably in all, an effusion does occur into the peritoneum in sufficient quantity to be easily recognised on palpation and percussion. Hildebrandt lays stress upon the occurrence of postoperative hyperæmia, which causes a plastic outpouring around the tuberculous nodules, resulting in their fibrous encapsulation. This is a method of "cure" constantly seen elsewhere.

Murphy writes: "If the peritoneum be inspected three or four days after the laparotomy, as I have had opportunity to do on more than one occasion, it will be found intensely congested, its vascularity greatly increased, its gloss almost or quite abolished, and the fluid, not fresh, clear serum, but cloudy or seropurulent, showing the most active proliferation. It is this tissue proliferation which overwhelms and encapsulates the tubercular foci on the surface of the peritoneum." If the primary focus is the tube, removal of the fluid allows the open tube to fall against the peritoneum, to contract adhesions, and at last to become securely walled off from the general peritoneum. Here, as in so many other parts, the "cure" of tuberculous areas means the encapsulation of the bacilli in the firm grasp of newly formed fibrous tissue.

[I would refer readers interested in this subject to two extremely valuable papers, Dr. J. B. Murphy's "Tuberculosis of the Female Genitalia," and Dr. W. J. Mayo's article in the "Journal of the American Medical Association," April 15, 1905.]

CHAPTER VIII.

SUBPHRENIC ABSCESS.

An abscess beneath the diaphragm, between it and the liver, may be either intraperitoneal or extraperitoneal; it may lie to the right or to the left of the suspensory ligament of the liver. The intraperitoneal form is decidedly more frequent than the extraperitoneal, and the abscess is more commonly found upon the right side.

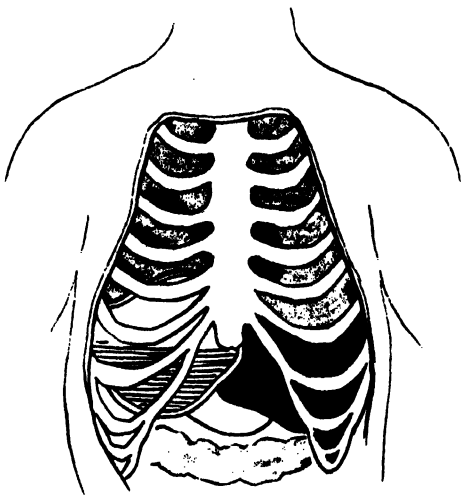


Fig. 20.—Subphrenic abscess (right side).

The upper and posterior surfaces of the liver are partly covered by peritoneum, partly devoid of any serous covering. The suspensory ligament forms an oblique partition, dividing the liver into a larger right, and smaller left, portion.

An abscess which lies to the right of the falciform ligament begins generally in inflammation affecting the gall-bladder, the liver, the kidney, or the appendix. An abscess which lies to the left of this ligament starts, in the majority

of cases, from a perforating ulcer of the stomach or duodenum, or from inflammation in the pancreas, intestines, spleen, or left kidney. The commonest source of infection I formerly believed to be the appendix, but recent statistics do not support this view. Körte has recently reported a series of 60

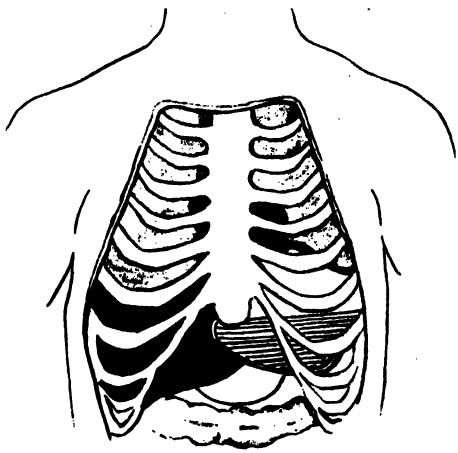


Fig. 21.—Subphrenic abscess (left side).

cases upon which he had operated, 40 patients recovering. The origin of the abscess was in the appendix in 27 cases; in the stomach in 9; the duodenum in 1; the spleen in 5. He gives the following statement:

Source of Abscess.	Number of Cases.	Recovered.	Died.
Appendix	27	18	9
Stomach	9	5	4
Duodenum	1	0	1
Spleen	5	3	2
Kidney	4	2	2
Liver and gall-bladder	2	2	0
Pleura	4	3	1
Costal	2	2	0
Pancreas	1	1	0
Hydatid	3	3	0
Undetermined	2	1	1
	60	40	20

Perutz ("Cent. f. d. Grenzgebiet. der Med. und Chir.," 1905, Nos. 4 to 10, inclusive) has collected the records of 208 cases. He gives the following table to shew the starting-point in his own series of cases, and in Maydl's and Körte's:

	In Perutz's Series	In Maydl's Series	In Körte Series
Stomach	67	35	9
Duodenum	3	8	1
Appendix	55	25	27
Liver and bile passages	17	20	2
Hydatid	5	17	3
Intestine	7	5	0
Pancreas	4	0	1
Spleen	4	0	5
Kidney	7	11	4
Ribs	1	3	2
Intrathoracic	8	9	4
Female generative organs	6	0	0
Traumatic	8	6	0
Metastatic	5	11	0
Various and unknown	11	11	2
Total	208	179	60

E. R. Hunt ("Lancet," Dec. 17, 1904, p. 1718) reports 38 cases of subphrenic abscess occurring at St. Mary's Hospital. In 19 cases the primary lesion was situated in the stomach. The other probable causes were: duodenal ulcer in 3; hepatic abscess in 4; appendicitis in 3; perityphlitis in 4; malignant disease of the stomach in 2; renal calculus in 1; splenic abscess in 1; and injury in 1. Left-sided subphrenic abscesses were met with more frequently than right-sided, and in only 1 of the 19 cases consequent upon gastric ulcer did right-sided abscess occur.

"The pus was situated between the left lobe of the liver, the diaphragm, and the spleen. Sometimes the pus was situated to the left of the spleen, between that organ and the diaphragm. Of this group there were seven examples, all due to perforation through the posterior wall of the stomach. More rarely the abscess might be in front of the stomach and liver, being bounded in front by the diaphragm and ab-

dominal wall and behind by the left lobe of the liver and the stomach; of this group there were three examples. Right-sided subphrenic abscesses were nearly always situated between the liver and the diaphragm, their spreading left and right being prevented by the falciform ligament and the thoracic wall. They tended to extend downwards and backwards in a large number of instances, not infrequently reaching as far as the right kidney."

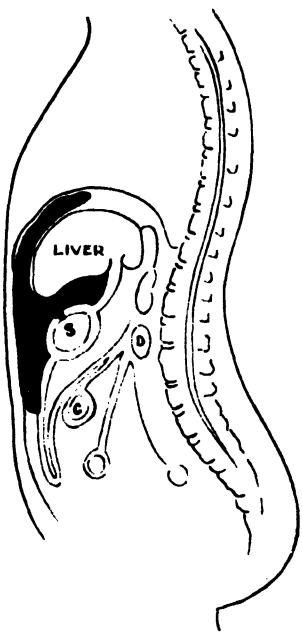


Fig. 22.—Subphrenic abscess in front of the liver.

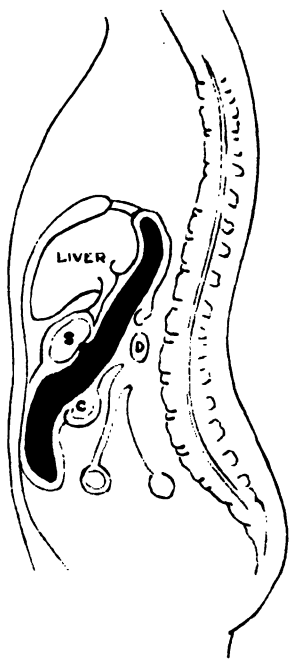


Fig. 23.—Subphrenic abscess in the lesser sac.

The inflammation from the appendix may spread upwards, within the peritoneal cavity, along the outer side of the colon, in the manner already described, or it may pass upwards in the loose cellular tissue behind the colon.

When an ulcer of the stomach destroys, by slow degrees, the entire thickness of the wall, a "*chronic perforation*" occurs and a perigastric abscess results. In many cases this abscess lies immediately beneath the diaphragm.

Disease of the gall-bladder, bile-ducts, and intrahepatic ducts may all lead to diffuse suppuration between the liver and the diaphragm. Abscesses, at first within the substance of the liver, may, in a later stage, and in their gradual enlargement, burst through the bounds of the liver and become subphrenic.

In the majority of cases a subphrenic abscess contains gas, which is derived, as a rule, from the action of gas-forming bacteria, but may also come from a hollow viscus. For this reason gas is more often found to be present in an abscess on the left side than in one on the right.

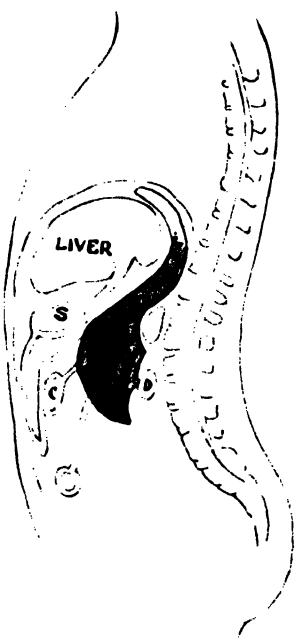


Fig. 24.—Subphrenic abscess; retroperitoneal.

The diagnosis of subphrenic abscess is often difficult, especially if there be no free gas within the cavity. When there is fluid, serous or purulent, at the base of the right lung, this difficulty is considerably enhanced. The physical signs that may be elicited are the following:

On the right side posteriorly there will be dulness at the base of the chest. If there be no free gas within the abscess, the liver dulness will merge above into the dulness produced by the overlying pus. The upper edge of this dull area will be convex. The physical signs are, therefore, the same, in such a case, as in a case of abscess of the liver. When, however, gas is present within the abscess, the signs are most characteristic. Percussion reveals three zones of different resonance, one above the other. The upper is the normal resonance of the lung; in the middle there is the tympany due to the gas within the abscess; in the lower, the dulness due to the fluid within

the abscess; this latter dulness merges into the dulness of the liver.

Abscesses on the left side, coming as they do from the stomach or duodenum, contain gas; the physical signs, therefore, are generally those which have just been described.

When pleuritic effusion is present above the subphrenic abscess, four zones of varying resonance may be encountered. The topmost is the normal resonance; the next is a dulness due to the pleuritic fluid; the next, a tympany due to the gas of the abscess; and, lowest of all, a dull area due to the pus in the abscess cavity.

An abscess on the right side may push the liver downwards. On both sides a bulging of the chest-wall or of the anterior abdominal wall may be seen.

The diagnosis in all cases must be verified by the examination of the chest with an exploring needle of fair size and of good length. As a rule, the most sensitive part of the dull area is selected for the introduction of the needle; repeated introduction of the needle may be necessary, for the pus is often thick and will not run easily through even a stout needle. In some cases there is a thick, tenacious layer of lymph on the upper surface of the liver, and this blocks the needle instantly.

The frequency of the association of pleural complications in cases of subphrenic abscess can only be gauged with certainty in cases which are operated upon by the transpleural method, or in those fatal ones where a postmortem examination is made. In Körte's series of 60 cases (reported by Grüneisen) pleural complications were found in 40. In Perutz's series of 208 cases it is noted that pleural affections were observed in 55, but in many cases the abscess was opened by median or lateral abdominal incision. In some no operation was performed; in some the clinical record is brief. Körte makes the interesting observation that in the cases where he performed a transpleural operation the pleura "was seldom free from disease."

OPERATION.

Subphrenic abscesses may be opened in one of four ways:

1. By incision through the anterior abdominal wall.
2. By incision along the lower costal margin.
3. By incision through the chest-wall and diaphragm.
4. By a combination of the thoracic and abdominal incisions.

1. Incision through the anterior abdominal wall is suited to those cases of large abscess which bulge forward in the epigastrium. These are, almost without exception, due to perforation of the stomach.

The abdomen having been opened, the abscess is reached, and its contents, often of amazing offensiveness, are evacuated. After the gas and much fluid have escaped, a pool of pus will be found to lie far back in the cavity. This must be mopped up with swabs and the posterior limit of the cavity defined. It will then generally be found necessary to make a counter-opening into the abscess from the loin in order to ensure efficient drainage. Both anterior and posterior wounds are drained. I have found the cigarette drain, of a diameter of an inch and a half, the best of all forms to use. The gauze which helps to form the "cigarette" may be very liberally besprinkled with boracic acid powder. The cavity may, if thought desirable, be washed out with hot saline solution or with a solution of peroxide of hydrogen.

2. The incision along the costal margin is carried through all the muscles of the abdominal wall. The further deepening of the wound is accomplished with great care, by blunt dissection with the finger, until the limits of the abscess are reached. A small opening is then made into the cavity and gradually enlarged in the direction in which it is clear that no harm can be done. This method is advocated by von Mikulicz for extraperitoneal abscesses on the right side.

3. The transpleural operation is that most often employed. An incision, five or six inches in length, is made over the ninth or tenth ribs, on the right side, and over the seventh or eighth on the left side, the middle of the incision being at the point from which pus has been withdrawn by the exploring needle. The ribs are exposed, and about 3½ or 4 inches of each are excised. The condition of the pleural cavity is then determined. If it is empty or contains only clear fluid in small quantity, it must be protected from infection, either by packing the wound tightly with gauze and postponing the completion of the operation for twenty-four hours, or by the introduction of stitches which include the diaphragm, both layers of the pleura, and the chest-wall. After the stitches have been passed, a little gauze packing is pressed around the edges of the wound so as to form a sort of barrier. The diaphragm is then incised, the cut edges seized with forceps and drawn forwards (this is generally easily accomplished as the diaphragm is pushed well upwards by the abscess beneath it), and the cavity emptied, washed out gently, and drained with a large cigarette drainage-tube.

4. A combination of the thoracic and abdominal incisions is in some instances an advantage in that it secures a more certain drainage. The thoracic incision is carried on to the abdomen, and the cavity above the liver freely opened. An abundant supply of gauze is introduced into the cavity and frequently removed in order to ensure free drainage and a speedy healing.

Perutz gives the following tabular statement of the results of cases treated by operation in the three series already mentioned:

TABLE OF CASES TREATED BY OPERATION.

	In Perutz's Series			In Maydl's Series			In Körte's Series		
	Total	Recovered	Died	Total	Recovered	Died	Total	Recovered	Died
Stomach	47	33	14	10	3	7	9	5	4
Duodenum	1	0	1	2	0	2	1	0	1
Appendix	40	30	10	14	9	5	27	18	9
Liver and bile passages	12	11	1	5	4	1	2	2	0
Hydatid	4	3	1	14	8	6	3	3	0
Intestine	6	2	4	2	0	2	0	..	..
Pancreas	3	1	2	0	..	..	1	1	0
Spleen	3	3	0	0	..	..	5	3	2
Kidney	6	5	1	7	1	6	4	2	2
Ribs	1	1	0	3	3	0	2	2	0
Intrathoracic	6	5	1	2	1	1	4	3	1
Female organs	5	4	1	0	..	..	0	..	..
Traumatic	7	7	0	6	6	0	0	..	..
Metastatic	5	4	1	3	1	2	0	..	..
Various and unknown	9	7	2	6	3	3	2	1	1
Total	155	116	39	74	39	35	60	40	20

The two most striking facts brought out by this table are the diminution in the mortality during the last few years, and the small mortality in those cases where the abscess depended upon diseases of the liver- or bile-passages. The cases in Maydl's series were treated up to the year 1894, in Perutz's series from 1894 to 1904. The mortality in the first series was 48 per cent.; in the second 26 per cent.

Perutz also analyses the 53 cases in which no operation was performed. Of these 44 died and 9 recovered, a mortality of about 85 per cent. In Maydl's unoperated cases, 104 in number, there were 98 deaths.

CHAPTER IX.

THE SURGICAL TREATMENT OF VISCERAL PROLAPSE.

THE SURGICAL TREATMENT OF GASTROPTOSIS.

GASTROPTOSIS is a disease, the frequency and significance of which are variously estimated by different writers. Glénard found a condition of enteroptosis in 400 out of 1300 patients, and has given us the most complete description of the disease which has been published.

The circumstances which are present are these: There is a weakening of all the natural supports of the viscera; the peritoneal ligaments are long, lax, and unequal to their burden, and the abdominal wall in its lower part is pushed forwards, bulging in characteristic fashion; a passive dilatation of any parts, or of all parts, of the alimentary canal may be present.

The patient complains chiefly of a sense of a heavy weight, of dragging, and of weariness in the abdomen. There is often nausea, and sometimes vomiting; there are fulness, flatulence, eructations. The bowels act irregularly, and constipation is always a prominent feature. The patient is almost always a neurasthenic of a most pronounced type.

An examination will disclose the circumstances mentioned above—a laxity of the supports and consequently an undue mobility of all the organs in the abdomen.

In the great majority of cases relief is afforded by the wearing of an abdominal belt. In some cases, however, the wearing of a belt has proved ineffective and resort has been had to surgery. The operation practised is known as "gastropexy."

Duret's Operation. -It is to Duret, of Lille ("Revue de Chir.," 1896, p. 430), that we owe the first suggestion for the performance

of the operation of "gastropexy." His patient was a married woman who had suffered very severely for three years from gastroptosis. The method adopted for the purpose of fixing the stomach up to the abdominal wall in approximately its proper position was as follows: A long incision was made in the abdominal wall from the xiphoid cartilage to the umbilicus down to the peritoneum. The peritoneum in the upper part of the wound was not incised, but was bared on its anterior surface by

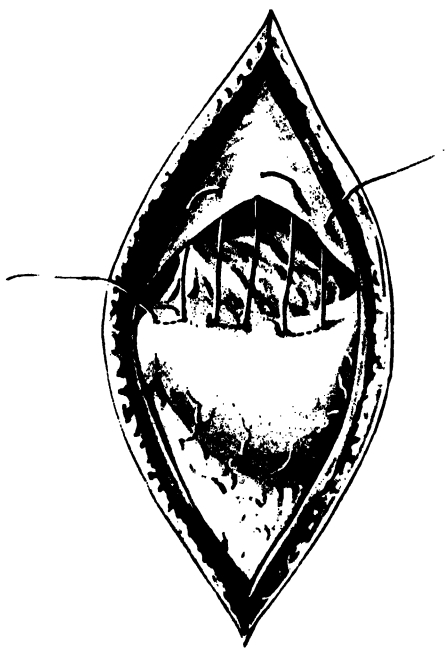


Fig. 25.—Gastropexy; Duret's operation.

stripping away the recti from it. The abdomen was opened through the lower part of the peritoneum. The stomach was then sought. Through the stomach and the undivided peritoneum in the upper half of the wound a suture was passed. The suture was of silk and was continuous; it was passed at first through the left edge of the parietal incision, through fasci, rectus muscle, and peritoneum, and then horizontally through the serous and muscular coats of the stomach, close to the lesser curvature. The needle was now passed from

within outwards through the uncut peritoneum, and then back into the abdomen, again to pick up the stomach as before. A series of loops of this suture were then taken. As soon as the stitch was tightened the stomach was slung upwards and there fixed. The patient did well, was relieved of

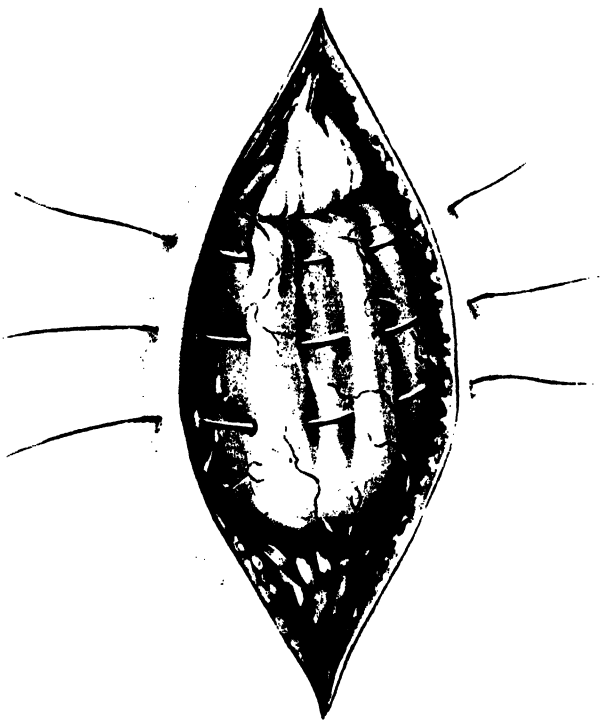


Fig. 26.—Gastropexy; Rovsing's operation. The area between the stitches is scarified with the intention of promoting firmer adhesions.

her very distressing symptoms, and in two years had gained 25 pounds in weight.

A similar operation to this was performed by Davis, but in place of the stomach the lesser omentum above the stomach was picked up by the stitch.

Rovsing's Operation.—Rovsing, of Copenhagen, has per-

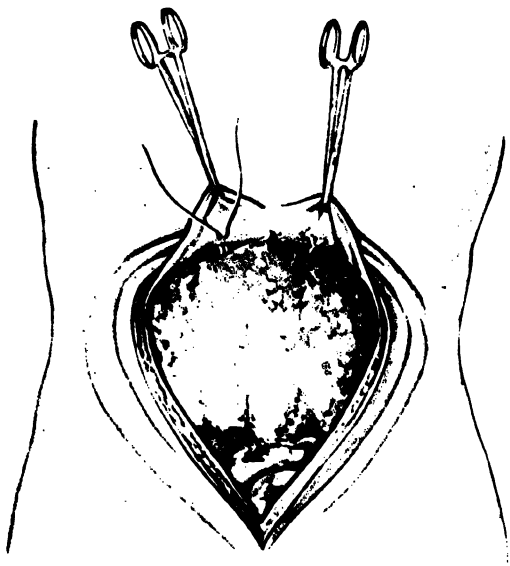


Fig. 27.—Gastropexy; Coffey's operation. The suture of the omentum to the anterior abdominal wall.

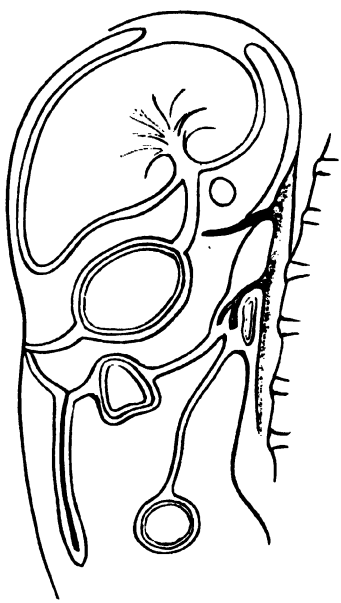


Fig. 28.—Gastropexy; Coffey's operation. The suture of the omentum to the anterior abdominal wall.

formed a large number of operations by a method of his own. The method consists in passing three stout sutures of silk transversely through the stomach, picking up only the outer coats. At each end the silk is tied over a glass rod, after being taken through all the layers of the abdominal wall. The stitches are removed at the end of four weeks, when the stomach is "solidly fixed" to the anterior abdominal wall.

Rovsing describes two forms of gastroptosis: (1) That which he describes as "virginal," which is the rarer but which is the more important, since the very great majority of the cases needing operation belong to this class. The abdominal wall is firm and strong. (2) That which occurs in multiparous women; it is often accompanied by considerable prolapse of other viscera, causes little pain, and is often relieved by well-fitting bandages.

Bandages are of no value in the "virginal" form because the abdominal wall, being sound, does not allow adequate, properly directed pressure to be exerted by any external appliance.

Rovsing has operated upon 49 cases; 44 belonged to the "virginal" class, 5 to the "multiparous." In only 6 of the cases was there gastric stasis. All the patients recovered from the operation and all were relieved, with the exception of one case where there was also a narrowing (unnoticed at the time) of the duodenum due to old adhesions. In one case, gastropexy was combined with hepatopexy; in another, removal of the extremity of an enlarged left lobe of the liver was also performed.

Clarence Webster, in cases associated with divagation of the recti, remedied this condition by resection of the fascia and approximation of the muscles.

Coffey's Operation.—Coffey supports the stomach by suturing the omentum along the greater curvature to the abdominal wall, above the umbilicus.

Beyea's Operation.—The most satisfactory method is probably that suggested by Beyea ("Philadelphia Med. Jour.," February, 1903, p. 257). The operation is described in the following manner:

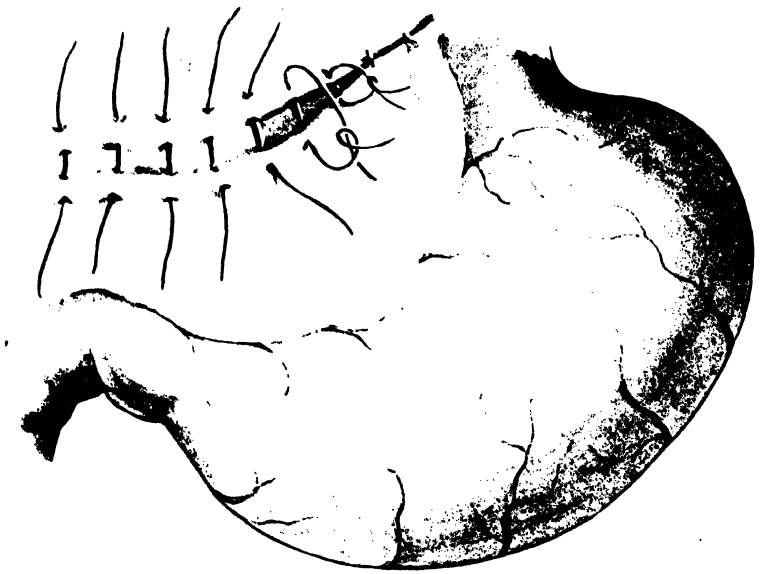


Fig. 29.—Beyea's operation for gastroptosis—the first layer of sutures.



Fig. 30.—Beyea's operation for gastroptosis—the first layer of sutures completed; the second and third being introduced.

"An incision, about three inches in length, was made through the linea alba, midway between the xiphoid cartilage and umbilicus. The tissues were separated in the usual manner and the peritoneal cavity opened, exposing a small portion of the lesser curvature and cardiac end of the stomach, the gastrohepatic ligament or omentum, gastrophrenic ligament, and the lower portion of the left lobe of the liver. The table was then elevated to the Trendelenburg position, and the stomach displaced still further downwards and out of the wound by means of gauze sponges. This procedure caused the gastrohepatic and gastrophrenic ligaments to be slightly stretched and separated from the underlying structures, which permitted an accurate determination of the length of these ligaments and very much facilitated operative manipulations. The gastrophrenic ligament was seen well developed, and evidently formed a strong support to the cardiac end of the stomach. The joining portion of the gastrohepatic ligament was composed of thin, delicate peritoneum, increasing in thickness and strength towards the right or pyloric end of the stomach. Retractors were introduced and the liver held aside by placing a gauze sponge beneath a retractor. Three rows of interrupted silk sutures were then introduced so as to plicate and thus shorten the gastrohepatic and gastrophrenic ligaments in the following manner: The first row, beginning in the gastrophrenic ligament and extending across the gastrohepatic ligament to almost opposite the pyloric orifice and hepaticoduodenal ligament, was introduced so as to form a plication in the centre of these ligaments, and included from above downward or vertically about 4 cm. of tissue (row No. 1). They were practically mattress sutures, including sufficient of the delicate tissue (1 cm.) to ensure against their tearing out. Five sutures, about one inch apart, were introduced from right to left, and caught in hæmostatic forceps. The next row (row No. 2) of sutures was introduced in the same manner, but 2.5 cm. above and below the first two. Then a third row (row No. 3) was introduced just above the gastric vessels and a short distance below the diaphragm and liver. The suturing was strictly confined to the normal ligamentary supports, and the distance between the rows from left to right was increased with the length of the ligaments, being greater towards the right. The gauze sponges were then removed, and the first,

the second, and finally the third row of sutures were secured, the stomach, particularly the pyloric end, being elevated to a little above the normal position."

The sutures were of silk. Four successful cases are recorded. A similar operation has been performed by Bier. In a recent letter Dr. Beyea kindly informs me that he has operated in 8 cases, with marked benefit in all. The first case remains well after about eight years. I have only once performed the operation, and the result has been very good.

The advantage of the operation just described is that it does not solder the stomach to the anterior abdominal wall, and, therefore, does not interfere with the proper mobility of the organ.

There are, doubtless, cases in which an operation of this kind is necessary. Such cases, however, are few. The treatment by external mechanical supports should always be given a long trial before surgical measures are advocated, and consideration must always be given to the fact that the patients are often of a profound neurotic type.

HEPATOPTOSIS.

By hepatoptosis is understood that condition of prolapse or dropping of the liver due to the inadequacy of the suspensory apparatus. A mere depression of the liver by fluid accumulations above it, or by lateral deviations of the spine, is, therefore, not included in the definition.

The condition was first accurately described by Cantani in 1866. Two forms are generally recognised:

(*a*) Partial hepatoptosis, in which there is a downward prolongation of a portion of the liver. This results in the condition known as "Riedel's lobe," "floating lobe," or "linguiform lobe."

(*b*) Complete hepatoptosis, in which there is a downfall of the whole organ.

The suspensory apparatus of the liver seems at first sight singularly unfitted for the burden that is laid upon it. The following are the chief means by which the gland is held in position:

1. The vena cava. It has been shewn by Faure that the most substantial support to the liver is afforded by the vena cava. He likens the relation of the vena cava and the liver to that which obtains in the case of the heart and the great vessels.

2. The ligaments proper to the liver.

3. The intra-abdominal pressure—due, in part, to the tension of the anterior abdominal wall, and, in part, to the presence beneath the liver of the mass of the stomach and intestines. The influence of this factor, which is considered of the first importance by Sappey, Landau, and others, is, by Faure, not altogether denied, but asserted to be quite insignificant.

The dropping of the liver is not a perfectly simple vertical movement. The posterior surface of the liver, owing to the strong attachment of the vena cava, moves the least; the anterior border moves the most. There is a sort of nodding movement, or a movement of rotation around a transverse axis through the posterior part of the organ. In addition it must be noted that the right, larger, lobe moves further downwards than the left lobe. The anterior sharp edge of the liver becomes, therefore, lower and lower, and the upper convex surface becomes, at the same time, more and more inclined to look forwards.

Associated in many cases with this downfall of the liver is a marked deformity, which consists most often in a flattening of the gland, especially of the right lobe. The anterior and inferior surfaces are increased at the expense, respectively, of the superior and the posterior surfaces. In not a few cases a deep transverse furrow is seen to lie along the anterior surface of the right lobe; the peritoneum which lines

this groove is thick and milky in its opacity. This shape of the liver is most often found in association with a Riedel's lobe.

"Riedel's lobe" is a downward projection from the right lobe of the liver, immediately to the right of the gall-bladder. In very rare instances the elongation may proceed from the quadrate lobe, immediately to the left of the gall-bladder. This linguiform process is associated almost always with gall-stones, and is caused, so it is said by Riedel, by the gradual distension of the gall-bladder dragging downwards that portion of the liver in its immediate vicinity. Both Riedel and Terrier have shewn—and the observation has been abundantly confirmed—that when the gall-bladder, so affected, is drained of its contents by the performance of cholecystotomy, the projection is gradually withdrawn, and the conformation of the liver returns slowly to the normal.

The symptoms which are caused by this downward slipping of the liver need not be detailed here. Suffice it to say that the patients who suffer therefrom are, in 90 per cent. of the cases, women, in whom a prolapse of other organs—the kidney, the stomach and intestines, and the uterus—can also be recognised. Hepatoptosis is only a part of a general visceral prolapse, a condition known as enteroptosis, or Glénard's disease. It is well known that the sufferers are, for the most part, neurotic in type.

TREATMENT.

As a rule, the most successful treatment consists in the application of a well-fitting belt. The type of inflatable rubber pad recommended by Byron Robinson is probably the most satisfactory of all. In the more obstinate cases surgical aid will be called in for the purpose of dealing with a painful "floating" lobe or of fixing a wandering liver which cannot adequately be kept in position by any mechanical support.

Riedel's lobe has been treated by excision, by fixation to the abdominal wall, and by cholecystotomy.

Removal has been performed by Langenbuch, Bastianelli, and Lockwood; it can be needed only when the lobe is the seat of a pain that cannot otherwise be relieved. Suture of the lobe to the parietes was first performed by Billroth in 1884; later, by Tscherning and Langenbuch. The performance of cholecystotomy for this condition is, of course, within the experience of many surgeons.

Total Hepatopexy.—The first operation *for the purpose of fixing the whole liver* was performed by Gerard-Marchant in 1891, though it had been suggested by Kisbert in 1884. He sutured the thin anterior edge of the liver to the costal margin by silk sutures. This method has been followed in the majority of subsequent operations. A portion of the liver substance has been picked up by a series of sutures of stout silk, and each suture fixed to the anterior abdominal wall or to the costal margin. For the purpose of carrying the suture through the liver the needle suggested by Kousnetzoff should be employed. In addition to the sutures so passed, undoubted help would be gained by the denudation, by vigourous gauze friction, of all parts of the liver, so that the formation of adhesions might be more certainly accomplished.

Legueu suspends the liver by a stout double thread which passes completely through it from side to side.

Péan, by a procedure which he called "cloisonnement peritoneal horizontal," was able securely to fix a mobile liver. He made a transverse incision through the anterior abdominal wall, replaced the prolapsed liver, and then erected a barrier below it by suturing the peritoneum of the anterior abdominal wall to that of the posterolateral wall.

Francke adopted the following plan: A series of sutures were passed along all the anterior margin of the liver except the part near to the gall-bladder, uniting this edge to the costal margin. Between the upper surface of the liver and the

diaphragm gauze was packed in and left for eight days. On its removal firm adhesions formed between the two apposed and granulating surfaces. Depage, in addition to the passing of sutures, has performed a resection of the abdominal wall.

The best plan to follow would seem to me to be this: To make an incision obliquely, about one inch below the margin of the costal cartilages; to replace the liver; to fix the anterior edge securely with several sutures to the costal margin; to pack in between the liver and the diaphragm and possibly also beneath the right lobe of the liver many strips of gauze, which should be left in place a week; to keep the patient absolutely at rest in bed (with the foot of the bed elevated a few inches) for at least one month.

It must be borne in mind that surgery is called for only in the most extreme cases, and regard must always be had to the fact that a neurotic element is a marked feature in all these patients.

SECTION II.

OPERATIONS UPON THE STOMACH.

CHAPTER X.

OPERATIONS FOR PERFORATING GASTRIC ULCERS.

THE perforation of a gastric or duodenal ulcer is one of the most serious and most overwhelming catastrophes that can befall a human being. The onset of the symptoms is sudden, the course rapid, and unless surgical measures are adopted early, the disease hastens to a fatal ending in almost every instance.

Perforation of the stomach is usually described as being of two varieties—*acute* and *chronic;* but there is, as I first pointed out, an intermediate class of cases, not embraced by either of these terms, which is best described as *subacute.*

In **acute perforation** the ulcer gives way suddenly and completely. A larger or smaller hole results, and through this the stomach-contents are free to escape at once into the general cavity of the peritoneum.

In **subacute perforation** the ulcer probably gives way almost as quickly as in the acute form, but, owing to the small size of the ulcer, or to the emptiness of the stomach, or to the instant plugging of the opening by an omental flap or tag, or to the speedy formation of lymph which forms, as it were, a cork or lid for the ulcer, the escape of fluid from the stomach is small in quantity and the damage inflicted thereby is less considerable. The symptoms at their onset may be as grave as those in acute perforation, but on opening the abdomen

the ulcer may be found to be sealed over, and no further escape of fluid is occurring.

In the subacute form of perforation I have found that there is always a complaint of greater discomfort for several days preceding the rupture. Vague general or localised pains have been felt in the abdomen, or a sharp spasm or "stitch" when the patient turned quickly or attempted to laugh. One girl, a housemaid, felt the pain down her left side, especially when reaching up to her work; another said it hurt her to bend, as her side felt stiff. These premonitory symptoms are important, and if recognised, they should enable us to take measures to prevent the occurrence of perforation. They doubtless have their origin in a localised peritonitis, and the stiffness is due to the unconscious protection of an inflamed area by a muscular splint.



Fig. 31.—A perforating round ulcer causing death in a lady of twenty-two. This is the common condition. There is a *chronic* ulcer with an *acute* perforation (Museum of Royal College of Surgeons of England, No. 2306).

In **chronic perforation** the ulcer has slowly eaten its way through the stomach-coats, and a protective peritonitis has had time to develop at the base. The escape of stomach-contents is, therefore, merely local; barriers of lymph confine the fluid to a restricted area, and perigastric abscess forms. A chronic perforation occurs more frequently on the posterior surface of the stomach, and the perigastric abscess occasioned thereby is recognised as "subphrenic." The acute and subacute forms of perforating ulcer are more common on the anterior surface.

There can be no doubt that recovery by **medical treatment** alone is possible both in the acute and in the subacute forms of perforation. I have had two cases under my care in which a diagnosis of perforation had been made by competent medical men. In both, an operation was impossible, as no skilled help was available until the urgency of the symptoms seemed to have passed off. When I operated, many months later, the evidence of peritonitis completely surrounding the stomach was undeniable. Though patients may recover, their recovery cannot be urged as a reason for the delay or withholding of surgical help in all cases, for the possibility of spontaneous recovery, though not denied, is yet so remote as to make it imperative to adopt operative treatment at the earliest possible moment. The risk of operation is definite; the hazard of delay is immeasurable. There are times when the diagnosis may be difficult. If morphine has been administered to still the intolerable pain, the patient's condition becomes placid and comfortable. It may be almost impossible then to recognise the extreme urgency of the case. In such circumstances I have, however, placed great reliance upon a continued hardness and rigidity of the abdominal muscles. Even when the patient expresses herself as free from pain; when the aspect has become natural; and when the pulse has returned to the normal, the abdominal rigidity remains. In the case of I. S., a girl of seventeen, upon whom I operated for a perforated duodenal ulcer, the medical man who sent her to the infirmary had diagnosed a perforated gastric ulcer and had told the patient and her parents that immediate operation alone could save her life. Having obtained consent to operation, he despatched the girl to the infirmary after giving a hypodermic injection of $\frac{1}{4}$ grain of morphine to lessen the distress of the journey. When I saw her, shortly after her arrival, she looked in perfect health, she had no suffering, and her pulse and respirations were normal. The abdomen, though not distended, was ab-

solutely rigid and immobile, and I did not hesitate to operate at once. In any uncertain case I should incline to operation rather than to indefinite postponement to solve the diagnosis.

I have seen a difficulty in diagnosis arise, and I know of three cases in which negative exploration has been performed, when the patient was a woman at the commencement of a menstrual period. From some unexplained and indeterminate cause a sharp attack of abdominal pain, followed by vomiting, distension, prostration, and collapse had occurred in all and had caused a confusion in the diagnosis. In the case under my own observation, a history of previous similar, though less severe, attacks at the menstrual epoch, and the absence of any marked abdominal stiffness or tenderness, though the belly was obviously distended, enabled me to negative the question of perforating ulcer of the stomach.

The Operation.—The operation should be conducted as speedily as possible, and all measures adopted to save the patient from shock.

The abdomen is opened in the middle line, above the umbilicus, by an incision of ample size. The work which it is necessary to do cannot be efficiently done through a small opening—the surgeon must not be cramped. It is quicker to stitch up a large wound than to operate through an unduly small one. As soon as the abdomen is opened, gas or a little thin, clear or turbid fluid will escape. Both gas and fluid are inodourous, and when the fluid is examined, it is found in many cases to be sterile. The amount of gas and of fluid will depend upon the length of time that has elapsed since the perforation: if less than six hours have passed, there will be little or no gas, and the fluid will be clear or almost so. This fluid is poured out by the peritoneum as a protective measure, and is not only sterile, but is actively antibacterial. As more and more of the stomach-contents escape, the fluid becomes more turbid. Portions of semidigested

food may be found in the peritoneum, and I once saw an orange-pip there.

The ulcer is rapidly sought, and, as a rule, is found at once. It is recognised by the escape of fluid from it, by a thick deposit of lymph around it, or by the constant welling-up of fluid from a particular part of the stomach. As soon as the ulcer is localised, the stomach at that part is drawn well up into the wound, and a few swabs are packed around to prevent any further soiling of the peritoneum. The gap in the ulcer is at once closed by a single stitch which passes through all the coats of the stomach on each side of the perforation. This closes the opening and prevents any further escape of stomach-contents. If the stomach is full,—and it very often is,—it is a good thing at this stage to pass a stomach-tube and empty all the contents away. The stomach may also be gently washed out.

The perforation will often be found surrounded by an area of very dense induration, in which a suture can find little security of hold. This induration is almost entirely due to œdema of the stomach-wall around the ulcer; it is not, as one might suppose from the feel of it, due to any cicatricial induration and contraction in the ulcer itself. Œdema alone causes it, for on postmortem examination of such cases the induration is always found to have vanished. There is no need to excise the ulcer, and this procedure is, in so far, harmful that it wastes a few seconds and causes sometimes not a little bleeding. Excision of the ulcer is, however, performed as a routine measure by some surgeons. The perforation, having been closed by a single stitch, is now effectually sealed by infolding the stomach-wall by a double layer of suture. I always use thin Pagenstecher thread and the curved intestinal needle for this purpose. The first suture begins about one inch away from the ulcer, and continues beyond the ulcer about one inch. The second stitch is applied beyond the first, which it infolds.

In some instances the closure of the gap may be difficult. The opening may be almost inaccessible, being on the lesser curvature, close to the cardiac orifice. In these circumstances the application of sutures in the ideal method just described may be physically impossible. The only plan, then, to adopt is to take one or more interrupted sutures through or outside the ulcer and make a closure of the perforation that will, at the least, be temporarily efficient. To make the sealing-off complete, an omental graft or flap is then applied over the stitches. The left end of the omentum is sought and turned upwards over the stomach, where it can be fixed by one or more stitches. In one case I have adopted this plan with perfect success when satisfactory closure by suture alone was impossible.

The perforation being closed, attention must be paid to the toilet of the peritoneum. The shorter the time that has elapsed since the giving-way of the ulcer, the less will there need to be done. If the patient is operated upon within the first four or six hours, very little cleansing will be necessary. A few sterile swabs passed to the back of the abdomen, above the lesser curvature, above the liver, and into each renal pouch, will ensure that all is made clean. The abdomen can then be closed without drainage.

If, however, more than twelve hours have elapsed since the perforation, greater care and longer time must be spent on ensuring that all is clean. Hot moist swabs are passed into all the nooks and crevices of the abdomen. Especial care must be taken to see that the parts immediately beneath the diaphragm are thoroughly cleansed—for the risk of subphrenic abscess or of a spreading of a septic inflammation through the diaphragm, giving rise to pleurisy or empyema, is by no means inconsiderable. It is absolutely necessary that these upper parts of the abdomen should be left as clean as it is possible to make them. If careful, methodical, painstaking sponging will not suffice, flushing with hot sterile salt

solution may be adopted. The kidney pouches, and in some cases the pelvis, need also to be cleansed. If the perforation has occurred more than twenty-four hours before the operation, a very thorough cleansing will be necessary, and in such cases a second incision above the pubes may be made for drainage. Finney suggests the making of multiple incisions for purposes of flushing and drainage, and in advanced cases of peritonitis nothing else is so effective. The question of drainage can be decided only by the surgeon himself in each case. If possible, drainage should be avoided, but in cases of over twelve hours' duration it is probably necessary in at least one-half of them. Drainage, when used, should be free, and, as a rule, I prefer the "cigarette" drain to any other. When the ulcer has been sutured, a careful search must be made for other ulcers which may have perforated. In two cases of my own two ulcers had simultaneously, or almost simultaneously, perforated. In the first, the two ulcers were exactly opposite each other—one on the anterior, one on the posterior, surface. In the second, the two ulcers were both on the anterior surface, about 1½ inches apart. It has been computed, from a large number of statistics, that two ulcers, or more than two, perforate in 20 per cent. of the whole number of cases. I have already referred to the necessity, in many cases, of emptying the stomach, and perhaps of gentle lavage also. This point is one which I have not seen mentioned in the writings of any surgeon, but it is, I am convinced, an important one.

One question which in the future will need full discussion is the necessity, or the propriety, of performing gastro-enterostomy after the ulcer has been securely closed. It has been shewn that multiple perforations of ulcers may occur; and I have, in several papers, pointed out that the statement universally made in text-books of medicine that gastric ulcer is solitary is erroneous. Gastric ulcer is often, indeed, as a rule, multiple. Therefore, any patient who has a perforating

ulcer probably has others which have perforated, or may do so at some future time, or may give rise to symptoms of "indigestion" when recovery from the operation is complete. The surgeon is now called in to see cases of perforating ulcer at a much earlier stage than was formerly the case, and there is, therefore, not the same need for an extremely rapid operation. The additional time spent over the performance of gastro-enterostomy would not increase the risk of the operative treatment in many patients, and inasmuch as it would give rest to the stomach, it would afford a better chance of rapid healing in the sutured ulcer. In three cases I have performed gastro-enterostomy when operating for a perforating ulcer, and I am strongly of opinion that in the future, when cases are seen in the earliest stage, gastro-enterostomy must be more frequently performed.

In some cases, of course, such as that upon which I operated, where the suture of the ulcer, necessary for its closure, caused marked narrowing of the duodenum, gastro-enterostomy must always be performed. In other cases the question as to its necessity will be determined partly by the position of the ulcer, the amount of its induration, the question as to whether it has caused, or is now causing, stenosis, and partly by the discovery or otherwise of ulcers elsewhere. In several recorded cases death has resulted after successful closure of a perforating ulcer, from hæmorrhage or perforation of other ulcers in the stomach or in the duodenum.

As soon as the operation is completed, the patient is given an enema consisting of 10 ounces of saline solution with one ounce of brandy. This is repeated every three or four hours. No fluid is given by the mouth for at least twenty-four hours, and, if possible, not for forty-eight hours. The mouth is frequently rinsed, and the teeth are brushed. This will keep the mouth moist, and will lessen the sense of thirst. If needed, subcutaneous or intravenous injections of saline solution may be given.

When the patient has come round from the anæsthetic, she is propped up in bed with about five pillows or with the bed-rest. This semi-sitting posture is necessary as affording drainage of fluids away from the diaphragm, and as being decidedly more comfortable for the patient. For the first few days a careful note must be taken of the pulse-rate and of the rate of the respirations. The most dreaded complication in cases of this kind is the occurrence of some septic inflammation beneath the diaphragm (subphrenic abscess) or in the chest (pleurisy or empyema). After forty-eight hours the patient may be given sips of water, milk and water, a little wine and water, or tea. It must be remembered that there is need for careful dieting perhaps for some weeks after the operation.

PERFORATING DUODENAL ULCER.

In certain particulars the symptoms and the treatment of perforating duodenal ulcer differ from those of perforating gastric ulcer.

A duodenal ulcer may perforate at once and acutely into the peritoneal cavity, or may slowly destroy all the coats of the bowel and lead to the formation of a localised encysted abscess. If the former, the fluid escaping from the viscus is free to run at large in the peritoneal cavity. In many of the cases, as is seen from a study of the records, a well-defined path is taken. The fluid (generally mucus, more or less tinged with bile) escapes on to the upper surface of the transverse mesocolon to the right of the hillock which is formed by the fitting in of the transverse colon to the greater curvature of the stomach. It, therefore, tends to run to the right to the hepatic flexure, and then to descend along the outer side of the ascending colon to the iliac fossa. There collecting, it may cause symptoms strongly suggestive of appendicitis. From the iliac fossa the fluid drains to the pelvis, and, filling that, overflows into the left iliac fossa. If an abscess

forms, it may be bounded by lymph, by the liver, or by intestines. Meunier describes a local abscess in his case as being bounded by the quadrate lobe of the liver, the gall-bladder, and the transverse mesocolon. Lennander relates a case where an abscess was hemmed in on all sides by intestine. The perforation of such an abscess may lead to acute septic generalised peritonitis, as recorded by Planchard. Perforation of the upper portion of the duodenum may lead to subphrenic abscess. Seven cases of this kind are related in Maydl's monograph. An ulcer may destroy all the coats of the bowel, and its base be formed by the liver (Keyl, Herzfelder, Collin) or by the gall-bladder (Krauss, Moynihan). An ulcer may destroy all the coats of the bowel and perforate a hollow viscus, forming an "internal duodenal fistula." Rokitansky describes a case of gastroduodenal fistula; Hoffman and Gross, cases of cholecystoduodenal fistulæ; and Dudensing a case where the ulcer had perforated the pancreatic duct. An ulcer may destroy all the coats and lead to the formation of an abscess, which bursts upon the surface of the body, forming an "external duodenal fistula," as recorded by Lumeau and Bucquoy. The duodenal wall may be ulcerated through by an abscess arising from without, as in the case of lumbar abscess bursting into the duodenum close to the biliary papilla under the care of Davies-Colley.

At the first the **symptoms** of a perforated duodenal ulcer are precisely similar to those seen in cases of perforated gastric ulcer, but after the first shock has passed the symptoms and signs of gastric and duodenal perforation differ in their development. When the ulcer is in the stomach, the signs are those of general peritoneal involvement; when the ulcer is duodenal, the course taken by extravasated fluids leads to a more acute and an earlier involvement of the peritoneum on the right side, and in the right iliac fossa. The clinical picture of appendicitis is copied with such accuracy that in 49 recorded cases tabulated by me in the "Lancet," of December, 1901, in 18

the first incision was made over the appendix after a diagnosis of acute appendicitis had been made. In the final stage, the peritoneal infection is universal.

When the abdomen is examined even within the first three or four hours, a greater resistance and a more marked tenderness may be found upon the right side, and the tenderness over McBurney's point may be exquisite.

The **diagnosis** is much simplified if melœna or other signs or symptoms of duodenal ulcer have been noticed before the onset of the perforation. It is, however, unusual for patients to notice anything more than an occasional "hunger-pain," which is eased by a glass of milk or the nibbling of a biscuit.

When **operation** is performed, there may be great difficulty in exposing the ulcer. If the ulcer be in the first portion of the duodenum, it is generally easily discovered and easily sutured; if it be in the second portion, it may be impossible to suture. Whenever practicable, the perforation should be closed completely in the manner already described. By so doing, the lumen of the duodenum may be greatly narrowed, so that an alternative route from the stomach must be given by the performance of gastro-enterostomy. This was performed in one of my cases. When the ulcer is so deep that it cannot be sutured, as it has been in cases recorded by such expert surgeons as Lennander and Mayo Robson, drainage must be adopted. The largest tube is passed down to the ulcer, and a gauze packing surrounds it, or a sort of funnel leading to the perforation may be constructed out of the omentum. If the condition of the patient would allow of it, the duodenum near the pylorus might be closed by a circular purse-string suture and gastro-enterostomy performed.

The following table shews at a glance the chief points of interest in my series of cases:

Sex.	Age.	Previous Symptoms.	Location.	Condition Found and Treatment Adopted.	Time Before Operation.	Result.
F.	39	No history taken.	Stomach.	Small opening near lesser curvature. Lavage. Drainage.	30 hours.	Recovery.
F.	27	Under treatment during last 12 months.	Stomach.	Large perforation just below lesser curvature near cardia. Drainage.	21 hours.	Death from shock
F.	20	Under treatment some months ago.	Stomach.	Large opening admitting middle finger. On anterior surface near the cardia. Drainage.	42 hours.	Death from shock.
M.	44	For eighteen months.	Duodenum.	Opening ¾ inch in diameter at beginning of second portion. Closure. Gastro-enterostomy (Murphy). Drainage.	26 hours.	Death from shock.
F.	28	For eight years.	Stomach.	Opening near lesser curvature towards cardia. Stitched, omental flap. Drainage.	28 hours.	Death in fourth week from subphrenic abscess and suppuration in abdomen.
M.	23	For several months.	Stomach.	Opening size of a sixpence on anterior surface near pylorus. Drainage.	35 hours.	Death; hæmatemesis for two days; two other ulcers found postmortem.
M.	25	For four weeks.	Duodenum.	Opening size of No. 8 catheter 1 inch from pylorus. Drainage at wound and above pubes also.	3 hours, 50 minutes.	Recovery.
F.	24	For three months.	Stomach.	Anterior surface near cardia. Suture and omental flap. No drainage.	36 hours.	Recovery.
F.	17	For eighteen months several attacks of hæmatemesis.	Stomach.	Anterior surface near lesser curvature, omental flap. No drainage.	16 hours.	Death in fifty hours with very high temperature.
F.	18	For a few weeks.	Stomach.	Opening size of lead-pencil near lesser curvature and towards cardia. Omental flap. No drainage.	17 hours.	Recovery.

Sex.	Age.	Previous Symptoms.	Location.	Condition Found and Treatment Adopted.	Time Before Operation.	Result.
F.	23	For several months.	Stomach.	Two ulcers, 1½ inches apart, on anterior surface near lesser curvature. Omental covering. Drainage.	20 hours.	Recovery. Subsequent gastro-enterostomy for indigestion, hæmatemesis, etc.
F.	31	For several years. Very severe for twelve months.	Stomach.	Posterior surface near lesser curvature. No drainage.	8 hours.	Death from empyema in fourth week.
F.	17	For twelve months.	Duodenum.	Subacute perforation. Closure. Anterior drainage.	4 days.	Recovery.
F.	25	For twelve years. Vomiting frequently during 2 years.	Duodenum.	First portion. Perforation occurred while in hospital waiting for operation; closure and gastro-enterostomy. No drainage.	4 hours.	Recovery and has since been quite well.
F.	30	For fifteen months.	Stomach.	Hour-glass stomach, perforation in centre; closure and gastroplasty. Drainage.	18 hours.	Recovery; quite relieved of her former symptoms.
F.	20	Under treatment twelve months ago for several months.	Stomach.	Opening size of a sixpence on anterior surface near lesser curvature and cardia. No drainage.	18 hours.	Recovery.
M.	22	For six weeks.	Duodenum.	First portion. Suture. First incision exposed appendix, which was removed; other cause being needed to explain condition led to second exploration over duodenum.	2 hours.	Recovery; quite well.
F.	33	For several years.	Stomach.	Posterior surface near cardia. Subacute. Anterior and posterior drainage.	3 days.	Recovery.
M.	40	Under treatment twice during last 2 yrs. hæmatemesis recently.	Duodenum.	First part. Rupture due to trauma, enormous gaseous distension of abdomen, pus everywhere. Drainage.	72 hours.	Death.

Sex.	Age.	Previous Symptoms.	Location.	Condition Found and Treatment Adopted.	Time Before Operation.	Result.
M.	44	For many years.	Stomach.	At pylorus large perforation in centre of mass equal to a Tangerine orange. Perforation occurred while in nursing home awaiting operation. Gastro-enterostomy also performed.	3 hours.	Recovery.
M.	42	For many years.	Stomach.	A small ulcer near the cardiac end and almost on the lesser curvature.	8 hours.	Recovery.
M.	46	For four months.	Duodenum	Acute perforation; closure. Gastro-enterostomy.	3 hours.	Recovery.
M.	38	For many years.	Stomach	Small ulcer at lesser curvature.	8 hours.	Recovery.
F.	46	For many years.	Stomach and Duodenum	Ulcer in stomach sutured. 11 days later perforation of duodenal ulcer; shock; collapse.	16 hours.	Death.

I once operated upon a case of carcinoma in which perforation occurred. I closed the perforation and performed gastro-enterostomy. The patient still lives, in comfort, though jaundice has recently appeared. The operation was performed in May, 1904.

Mr. T. Crisp English, in a detailed and most careful analysis of 50 consecutive cases of perforated gastric and duodenal ulcer treated by laparotomy at St. George's Hospital, gives the following tables:

	Gastric Ulcer.		Duodenal Ulcer.	
	Cases.	Recovered.	Cases.	Recovered.
1892	1	0	0	0
1893	1	0	0	0
1894	3	1	2	0
1895	3	1	0	0
1896	3	2	1	0
1897	5	3	0	0
1898	6	1	2	1
1899	3	2	0	0
1900	4	2	0	0
1901	2	1	1	1
1902	4	3	2	0
1903	7	6	0	0
	42	22	8	2

RECOVERIES.

Gastric ulcer	52 per cent.
Duodenal ulcer	25 " "

AGE AND SEX.

Perforated Gastric Ulcer.

Males	9 cases.	Average age	37.3
Females	33 "	Average age	26.4

Perforated Duodenal Ulcer.

Males	6 cases.	Average age	34.6
Females	2 "	Average age	24.5

PREVIOUS HISTORY OF CASES.

No gastric symptoms	5
Definite gastric symptoms without hæmatemesis	26
Hæmatemesis	8
Former dyspepsia	6
Not known	5

Symptoms immediately preceding perforation.

No special symptoms	40
Hæmatemesis	2
Under treatment in hospital	2
Under treatment as out-patient	1
Increasing pain and vomiting	5

INCIDENCE OF COMPLICATIONS.

	Non-fatal Cases.	Fatal Cases.
Parotitis	4	1
Pleurisy (plastic or serous)	6	9
Empyema	0	2
Pneumonia	1	2
Pulmonary abscess	0	1
Thrombosis	3	0
Hæmatemesis	1	2
Hæmorrhage from another ulcer	0	1
Nephritis	1	0

AFTER-CONDITION OF SUCCESSFUL CASES.

No gastric or other symptoms	11
Œdema of leg following thrombosis	1
Symptoms due to peritoneal adhesions	1
Dyspepsia (no symptoms of gastric ulcer)	4
Not traced	7
	24

CHAPTER XI.

OPERATIONS FOR HÆMORRHAGE FROM GASTRIC AND DUODENAL ULCERS.

The Treatment of Cases of Ulcer of the Stomach or Duodenum in which the Haemorrhage is Profuse.

HÆMORRHAGE.

THE bleeding from gastric or duodenal ulcers is recognisable either as hæmatemesis or as melœna. In lesser degree these symptoms are seen not infrequently; in their severer forms they are of dire significance, and may be the sole cause of the patient's death. It is but rarely that the surgeon is called upon for so momentous a judgment as is necessary in cases of severe hæmatemesis or severe melœna, for this condition of the patient is poor, even at times desperate. Operative intervention is therefore hazardous; yet a continued bleeding will, in certain cases, inevitably end in death.

It is necessary to emphasise the fact that hæmorrhage may manifest itself under entirely different circumstances in different patients. In some it is the earliest, and for a time the only, symptom of gastric disturbance; in others it is the last expression in a long and tedious course of symptoms. In other words, the hæmorrhage may occur from an *acute* or from a *chronic* ulcer of the stomach or duodenum. It will be found, when the clinical history of a series of cases is examined, that whereas in the latter the bleeding varies within the widest limits as regards both quantity and frequency, in the former the clinical history is repeated in case after case in a most remarkable manner.

Hæmorrhage from an Acute Ulcer.—Under the term "acute ulcer" of the stomach are probably included several varieties

of pathological conditions which are different in causation, different in destiny, but alike in the single fact that their clinical recognition is due to the bleeding which occurs from them, in abundant quantity. There is the ordinary peptic ulcer; there is the minute erosion, barely recognisable even on close scrutiny, which yet opens up a vessel; and there are "weeping patches" and "villous areas" and similar indeterminate and unnumbered conditions which have been recognised when the stomach has been explored during life. To the clinician all these conditions are betrayed by their tendency to hæmorrhage.

In almost every instance the hæmorrhage is the first symptom. Even on close enquiry it is difficult to elicit any history of antecedent gastric discomforts. The vomiting of blood comes unexpectedly and suddenly; a large quantity of blood is lost, and the patient suffers, often in an extreme degree, from the symptoms of hæmorrhage. The pulse becomes feeble and fluttering, the face waxen, the breathing rapid and shallow, the body-surface cold or clammy. For a time the symptoms may give rise to serious alarm, but a rally is seldom long delayed. The bleeding is checked spontaneously, and vomiting is rarely repeated, or, if repeated, the quantity of blood lost is but small.

In several of my cases a sudden, apparently causeless hæmorrhage has ushered in a long train of symptoms of dyspepsia. The acute ulcer has been the precursor, or rather the earliest stage, of a chronic ulcer.

The characteristics of hæmorrhage from an acute gastric ulcer are, therefore, spontaneity, abruptness of onset, the rapid loss of a large quantity of blood, the marked tendency to spontaneous cessation, the infrequency of a repetition of the hæmorrhage in anything but trivial quantity, and the transience of the resulting anæmia.

Hæmorrhage from a Chronic Ulcer.—The bleeding from a chronic ulcer of the stomach or duodenum may vary within the

widest limits both of frequency and of quantity. For convenience of description I should arrange the cases in four groups:

(1) In the first the hæmorrhages are latent or concealed. The blood is small in quantity, and may be recognised only after minute examination of the stomach-contents or of the fæces. The estimates given by various writers as to the occurrence of hæmorrhage in ulcer vary between 20 and 80 per cent., and we are entitled to assume that this wide divergence of statement is due not so much to differences in the symptoms of ulcer, as to the varying degrees of closeness with which the causes are observed, and to differences in the frequency and minuteness of examinations of the stomach-contents or the fæces. It would probably not be rash to assume that all ulcers of the stomach or duodenum bleed at some time or other, but if the bleeding be trivial and infrequently repeated, it is never likely to obtain clinical recognition.

(2) In the second group those cases should be included which are characterised by intermittent hæmorrhage. The bleeding is copious, but transient, and occurs at intervals of two, three, or more months. An exemplary instance of this class is the following:

A. S., female, aged twenty-eight. In May, 1898, the patient had a sudden attack of profuse bleeding from the stomach. She was in bed six weeks. For eighteen months after this her health was very poor; indigestion was constant, vomiting was occasional, constipation was invariable. For six months she was then in fairly good health and was able to take food much better. In April, 1900, indigestion became severe and a copious hæmorrhage again occurred. Treatment was continued for six months with much benefit. In January, 1902, a third attack of hæmatemesis and fainting; after this she was kept in bed for four weeks. In September, 1902, again hæmatemesis as severe as before. From then to January, 1903, she was under constant treatment, but improvement was very slow. Anæmia has been a prominent

symptom since April, 1900. At the operation a large ulcer was found in the stomach and a second in the duodenum. Gastro-enterostomy was successfully performed.

In all the cases in this group indigestion is a prominent symptom. The hæmorrhage often occurs without cause, but at times there may have been noticed an exacerbation of gastric discomfort and uneasiness for a few days. Anæmia is almost constant.

(3) In the third group the cases are characterised by hæmorrhages, which are rapidly repeated, and on all occasions abundant. In the majority of patients the symptoms of indigestion which have been noticed for months or years before have undergone an appreciable increase in the recent days. Then, suddenly, the hæmorrhage occurs—a large quantity, a pint or a pint and a half, of blood is vomited. The patient may faint from loss of blood; he shews always the general symptoms of bleeding. For twelve or twenty-four hours the vomiting ceases, to reappear at the end of this time, without apparent cause, and in equal or greater quantity. A second latent period is followed by a further hæmorrhage, and so the patient becomes in a condition of the gravest peril.

No better example of this class could be cited than the following:

M. W., female, aged twenty-four. Has suffered from symptoms of gastric ulcer, pain, vomiting, and inability to take solid food for fifteen months. Eleven weeks before admission to hospital all her symptoms became worse. Vomiting became frequent; pain was almost intolerable. During the five weeks before admission she vomited daily, and on almost all occasions some blood came. While waiting in the hospital she vomited three times in five days, and on each occasion about half a pint of blood came. She was very blanched; pulse, 112. The motions were tarry on two occasions. At the operation two old scars and one shewing recent inflammation were seen. Gastro-enterostomy led to perfect recovery.

(4) The fourth group would comprise those cases in which

the hæmorrhage occurs in enormous quantity, inundating the patient and leading to almost instant death. The opening of the splenic artery, the aorta, the vena cava, or the pancreatico-duodenal vessels allows of the so rapid escape of blood that the patient dies as surely and as swiftly as if his carotid or femoral vessels were divided. Such cases, fortunately, are rare. In my own experience only one such example has occurred, a large oval opening being then found in the splenic artery.

If, then, we accept the classification of cases of hæmorrhages from gastric or duodenal ulcer into the four groups suggested, we may define their characteristics as follows:

1. The hæmorrhage is latent or concealed, is always trivial, and often inconspicuous.
2. The hæmorrhage is intermittent, but in moderate quantity occurring spontaneously and with apparent caprice at infrequent intervals. The life of the patient is never in jeopardy from loss of blood, though anæmia is a persisting symptom.
3. The hæmorrhage occurs generally, but not always, after a warning exacerbation of chronic symptoms. It is rapidly repeated, is always abundant, its persistence and excess cause grave peril, and will, if unchecked, be the determining cause of the patient's death.
4. The hæmorrhage is instant, overwhelming, and lethal.

THE TREATMENT OF HÆMORRHAGE.

In the treatment by operation of cases of hæmatemesis, the surgeon may be called upon to exert the utmost resources of his skill. The condition of the patient is serious, for bleeding must have recurred to make the operation necessary, and the search for the bleeding point may be prolonged or even fruitless. The necessary manipulations may be difficult, and the shock, therefore, of the operation may be profound.

In dealing with hæmorrhage from the stomach or duodenum two plans may be followed: By the *first*, the surgeon makes

a search for the ulcer or ulcers and deals with them directly by excision, ligation, cauterisation, or otherwise; by the *second*, he deals with the hæmorrhage indirectly by performing gastro-enterostomy as speedily as possible. By this operation the stomach is emptied and allowed to contract, and opportunity is thus given to the ulcer to heal.

With regard to the former method, the method of search for, and direct treatment of, the ulcer, it must be acknowledged that it is the more desirable. When a vessel is bleeding the surgical indication is to secure it with a ligature, or in some other direct method to effect its closure. In many cases this is possible. The ulcer can be felt when the stomach is gripped between the fingers, and it can then be easily excised. This I have done in four cases. In other instances, however, the ulcer may be found adherent to the pancreas, to the liver, or even to be excavating these organs; or, as in one case of my own, a large mass of induration may be found around the ulcer and innumerable dense adhesions may also be present; or more ulcers than one may be found—one ulcer may be felt in the stomach and one in the duodenum; or, finally, the most deliberate search of the whole stomach may fail to disclose any sign of ulcer. In all these circumstances the excision of the ulcer or the direct treatment of the bleeding point may be impossible, and recourse would then, of necessity, be had to the indirect method—the performance of gastro-enterostomy.

An enquiry into the records of cases which have been dealt with by the direct method shews that the bleeding point may be impossible to discover; that although blood can be seen to well up from the stomach-wall, no single point can be recognised as its source. The whole surface seems to be weeping blood. Furthermore, when a definite excavation or erosion or ulcer has been recognised and has been treated directly by ligation, cautery, excision, or curettage, and the stomach closed, the hæmorrhage has continued as freely as before, and has proved fatal. At the postmortem examination of such cases

a second ulcer or multiple ulcers may be found, or it may happen that no obvious source of the bleeding is discoverable. Local treatment of the supposed source of the hæmorrhage has, therefore, not always met with adequate success.

For these reasons many surgeons, including myself, have felt that, at any rate in the earlier cases treated, surgical methods have missed their mark. Painstaking investigation of the mucosa has proved futile, and ligation of the actual or supposed source of the blood has not achieved its purpose. The belief was, therefore, expressed, and acted upon, that in many cases local treatment was unnecessary; in many it was impossible; in all, the desired end, the arrest of hæmorrhage, could be secured at least as well as by other and safer methods. Gastro-enterostomy, it was found, led, in all my cases, to an instant cessation of the bleeding and to the speedy and complete healing of the ulcer. The explanation of this was, it seemed to me, as follows: in all cases of hæmatemesis or melœna the tendency to spontaneous cessation is known to be remarkable; the cause of the continuance of the hæmorrhage in certain cases, I concluded, after an examination of several cases during operation, must be distension of the stomach. In certain cases the stomach was so tightly inflated that manipulation of it was difficult; in one the distension was so marked that I had to puncture the stomach before beginning the anastomosis with the jejunum. The operation of gastro-enterostomy could be seen to result at once in an emptying of the stomach into the jejunum. In cases of hæmorrhage, therefore, I advocated the performance of gastro-enterostomy as the safest, speediest, and surest method of checking the outpouring of blood. My own practice has justified my advocacy of this method; in no case have I found reason to regret having adopted it. In all, the arrest of the hæmorrhage has been complete and permanent.

This, however, has not been the experience of others. Many cases are recorded where hæmorrhage continued after gastro-

enterostomy had been performed, and proved fatal. Kocher, Quénu, and Petersen all have met with this experience. In other recorded cases I am disposed to blame, not the gastro-enterostomy, for failing to arrest the hæmorrhage, but a Murphy button which had passed into the stomach, for causing its continuance.

Connell reports ("Annals of Surgery," November, 1904, p. 500) a case of repeated hæmatemesis for which he operated, performing gastro-enterostomy. The patient died on the fifth day, but though the intestine contained blood (as was to be expected), there was no hæmatemesis after the operation. At the postmortem, a typical round ulcer near the pylorus and the lesser curvature was found. The case is reported as shewing the unworthiness of gastro-enterostomy, but it seems to me that, judging from the published account, the arrest of the bleeding by the operation was entirely satisfactory.

The cases in which gastro-enterostomy has failed to arrest the hæmorrhage are few, and in some of these the means employed in making the anastomosis are perhaps not free from blame.

It is, therefore, clear that both the direct and the indirect method of dealing with the ulcers have at times proved unavailing. The safest course to pursue, whenever it is possible, is to secure, first of all, the bleeding point, if it can be determined with certainty, and subsequently to perform gastro-enterostomy. The operation is conducted in the following manner:

The abdomen is opened through or by outward traction of the right rectus muscle in the manner usual in gastro-enterostomy, and the stomach is exposed. In many cases it is found to be very greatly distended with air—to such an extent, it may be, that manipulation of it is difficult—and a puncture to allow of the escape of gas may be necessary before any manipulation can be accomplished. Terrier has recommended that the stomach should be emptied into the duodenum so as to save time. The stomach throughout the opera-

tion is handled with the greatest gentleness, for it is to be remembered that any rough measures may result in starting afresh a very profuse hæmorrhage. In the first place a most careful and detailed scrutiny of the whole of the outer surface of the stomach, both anterior and posterior, must be made. Any point where a puckering or opacity of the stomach is noticeable must receive especial attention. An ulcer, even when small, may be recognised, as a rule, by picking up the stomach-wall which it involves. When the wall is healthy, the mucosa, which feels soft and supple, slips away readily from between the fingers and thumb. When an ulcer is present, there are local stiffening and solidity and the mucosa cannot be detected, as it were, from the outer coats. The lesser curvature especially should be carefully examined, and, if need be, a small opening may be made in the gastrohepatic omentum, to enable a finger to be passed to the posterior surface of the stomach. The presence of an enlarged and inflamed gland, the "sentinel gland," is often, as F. B. Lund, of Boston, has well shewn, an indication of the site of the ulcer.

If, happily, an ulcer be found which is not adherent to any viscus, and which is comparatively small in size, it may at once be excised between two incisions enclosing an ellipse, which bears the ulcer. Excision of an ulcer on the free anterior or posterior surfaces is quite easy; when the ulcer is on the lesser curvature, it is more difficult, and if the parts near the cardia are involved, the greatest mechanical obstacles may be encountered.

If the ulcer involve the pylorus, causing a large inflammatory mass, it may be, in some few cases, necessary to perform pylorectomy.

If the ulcer is adherent, by firm attachment, either to the liver or to the pancreas, there will be little advantage to be derived from detaching the ulcer. In such circumstances it is probable that the safest treatment lies in the performance of gastro-enterostomy.

When, however, no ulcer can be found, then the stomach may be opened, and the whole of its mucous surface explored. Before this is done a number of flat swabs wrung out of hot sterile salt solution must be packed around the stomach so as to prevent the soiling of the peritoneum by fluids escaping.

The stomach is opened on its anterior surface by either

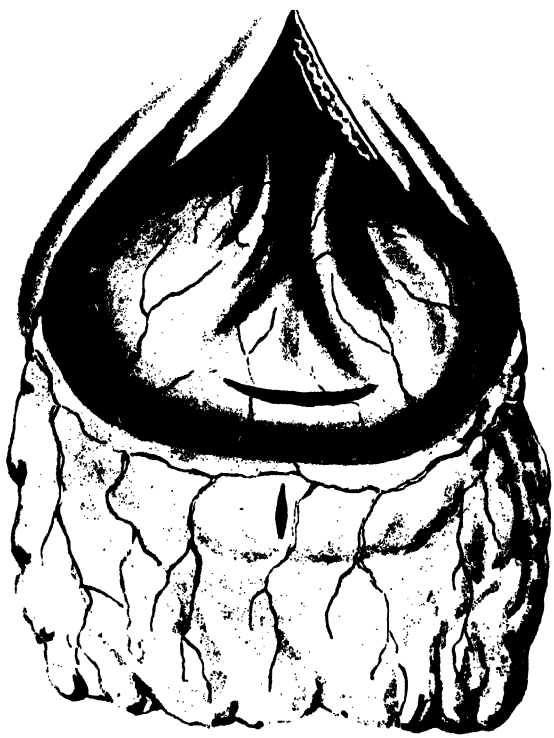


Fig. 32.—Exploratory gastrotomy. The stomach is incised and a slit made in the omentum above the transverse colon; through this slit the hand is passed to the posterior surface of the stomach (after Guibé).

a vertical or a transverse incision. The latter is preferable, for, though hæmorrhage is more severe, a far better view of the interior of the organ can be obtained. The cut edges of the stomach are seized with small French vulsella, and are held as widely apart as possible, while the fluids which well

up from the stomach are mopped away. When the stomach is dry, its mucosa is inspected in the best possible light, and, if necessary, a small Ferguson's speculum, previously sterilised, or Ott's speculum with the electric light, may be used to ex-



Fig. 33.—Protrusion of the posterior wall of the stomach through an anterior incision.

amine the parts remote from the incision. The exposure of the posterior wall is greatly facilitated by passing two or three fingers, or even the whole hand, through a rent in the gastrocolic omentum. The fingers press the posterior wall forwards through the open wound in the anterior surface, and, as the fingers are

made to travel backwards and forwards and from side to side, all parts are successively brought into view.

If an ulcer is found, its position is determined, and it is, if possible, excised. This may be done by cutting from the mucous or from the serous surface—but whichever is done,



Fig. 34.—The stomach is invaginated through the opening in the anterior wall (after Guibé).

it must be the surgeon's care to prevent soiling of the wound while this is being done. The opening left is closed by a double layer of stitches in the usual manner.

If no ulcer can be found, a variety of other conditions may be disclosed, each one being a possible source of hæmorrhage—"erosions," "abrasions," "punctate spots," "villous patches,"

are all mentioned in various records of operations. It is probable that local treatment of these conditions is not devoid of danger and is not productive of success. But ligation, the application of styptics, the application of the cautery, and so forth, have been all adopted. Ligation of a bleeding point on the mucosa is hardly possible: the mucosa is so soft and friable that it yields before the force of a tightening ligature.



Fig. 35.—Gastrostomy combined with gastro-enterostomy.

Ligation *en masse* has been suggested by Andreas and Eisendrath, and has been proved as sound by experiments upon animals. Savariaud has suggested that the ligation of a large vessel leading to the site of the ulcer might be of advantage. If any of these methods are tried, they should be supplemented by the performance of gastro-enterostomy.

When the exploration of the stomach is completed, the wound on the anterior surface is closed.

The infolding of an ulcer whose removal would be attended by very great difficulties may be desirable. The first layer of stitches used would be drawn very tight, so as to cut off the blood-supply to the ulcer. In some few fortunate instances the ulcer has been found on the posterior surface of the stomach near the greater curvature, and a posterior gastro-enterostomy has been performed at the opening left after the ulcer has been excised.

In a recent case I performed gastro-enterostomy first, after locating the ulcer, and then, finding that the patient could bear a further interference, I removed a large chronic ulcer from the lesser curvature. The ulcer may be treated by excision, by ligation *en masse* from within, by cautery, or by curettage; or the bleeding vessel may be secured from the mucous surface by a transfixing stitch, or the vessel, on the serous coat, which seems to be passing directly to the ulcer, may be secured. In any future desperate case where only the briefest interference could be tolerated, I should be disposed to infold the ulcer by a double layer of stitches, the first of which, drawn very tight and taking a deep hold of the stomach, would surely close the bleeding vessel. Partial gastrectomy, in rare, exceptionally favourable cases, may perhaps be necessary.

In addition to the performance of gastro-enterostomy, it has been suggested by Rutkowski and Witzel that a gastrostomy should be performed. This ensures a complete rest to the stomach for a period of six to eight weeks. The tube, which is fixed in the anterior wall, after the performance of gastro-enterostomy, leads into the distal limb of the jejunum; it is fixed into the stomach by a catgut suture and the gastrostomy valve formed by Witzel's, Kader's, or Senn's method. When food is introduced into the tube, it passes at once into the distal limb of the jejunum. The stomach, therefore, remains empty and at rest for several weeks and the nutrition of the patient is not impaired. In some cases gastro-enter-

ostomy with jejunostomy may be performed. This method has received the high approval of Professor von Mikulicz, who, in the discussion which followed the reading of my paper before the American Surgical Association in May, 1903, said: "In my opinion, in a case of acute hæmorrhage, gastro-enterostomy alone is not sufficient. We in Germany do a combination of gastro-enterostomy with jejunostomy. The gastro-enterostomy gives drainage, while the jejunostomy is to feed the patient for from six to ten weeks; this latter then is allowed to close. I consider this the operation of the future."

CHAPTER XII.

OPERATIONS FOR CHRONIC GASTRIC ULCER, PYLORIC STENOSIS, ETC.—GASTRO-ENTEROSTOMY.

POSTERIOR GASTRO-ENTEROSTOMY.

THE operation of posterior gastro-enterostomy is performed in the following manner:

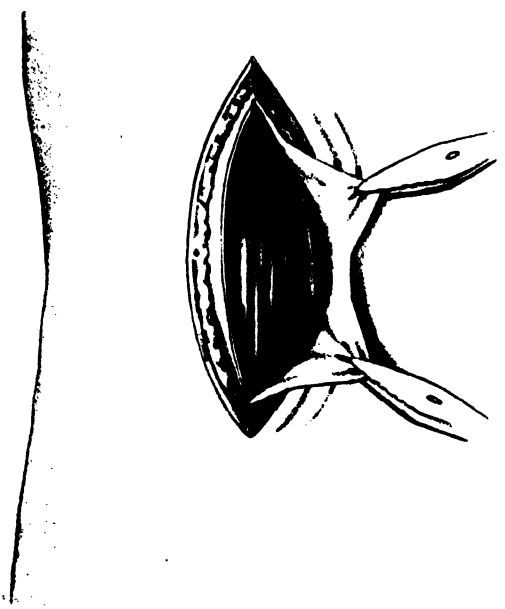


Fig. 36.—The abdominal incision in gastro-enterostomy; the anterior sheath of the rectus is stripped up to the middle line.

An incision about four inches in length is made about one inch to the right of the middle line above the umbilicus. The anterior sheath of the rectus is opened, and the fibres of the muscle are split, or, as is far better, the anterior sheath is dis-

sected up from the front of the muscle as far as the middle line; the whole body of the rectus is then drawn to the outer side, and the posterior layer of the sheath is incised along a line exactly behind the incision in the anterior layer. The abdomen is then opened.

An inspection of the whole of the stomach is necessary. It may be that an obvious thickening or puckering of an ulcer

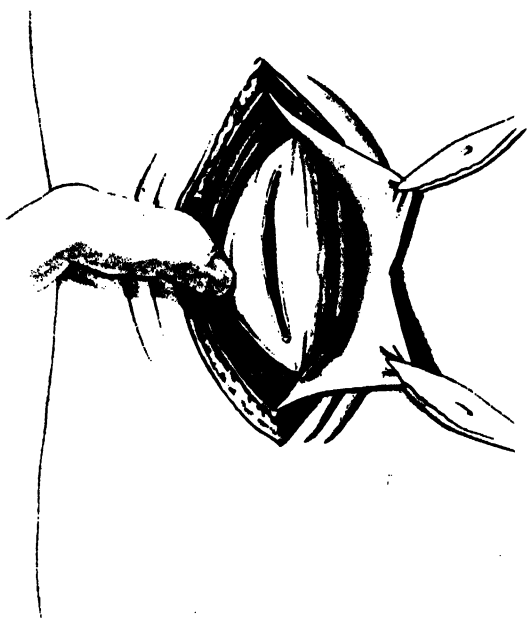


Fig. 37.—Incision of the posterior sheath after outward traction of the rectus.

at the pylorus is visible at once, but the surgeon must not rest content with this. A further search must be made on both the anterior and the posterior surface for other points of thickening. Not until the whole stomach has been felt and seen should any operation be performed upon it. Many mistakes have been made from lack of this precaution.

The posterior surface of the stomach is exposed by drawing the omentum and the transverse colon out of the abdomen, and making an opening through the transverse mesocolon into the lesser sac. It is sometimes not quite easy to divide the transverse mesocolon clearly, and in order to do so I have found the following method of great advantage:

The transverse colon and the stomach are held in the surgeon's left hand, and the mesocolon is made taut. At a blood-



Fig. 38.—The posterior surface of the stomach made to project through the incision in the transverse mesocolon.

less spot in the arch of the middle colic artery a clip is applied to the under surface of the mesocolon, and, having secured a firm hold, it is pulled away from the posterior surface of the stomach. A snip of the scissors by the side of the clip opens the lesser sac at once. The opening is enlarged by gentle stretching and tearing until three fingers can readily be passed through it. Through this opening the whole of the

posterior surface of the stomach is explored. Adhesions may be found between the stomach and the mesocolon or between the stomach and the pancreas, and it may be that these are so dense as to preclude the possibility of the performance of the posterior operation. Such cases are recorded. Though I have often found large adherent ulcers on the hinder surface, I have never been prevented from doing the usual posterior operation.

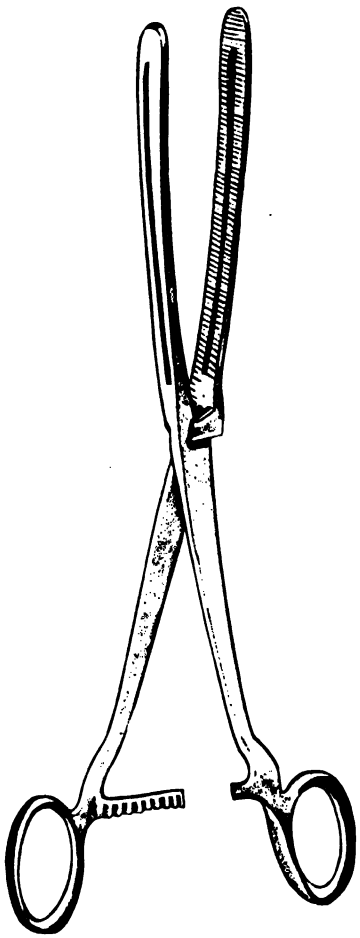


Fig. 39.—Moynihan's clamp for gastric and intestinal operations (made by Down Brothers, London).

The inspection and investigation of the stomach being complete, the anastomosis may be made. In deciding upon the part of the stomach to be used, it is important to select the lowest part of the greater curvature. To do this, the stomach is placed in its usual position and the lowest point is determined. As the stomach is again turned over to expose the posterior surface, this spot is covered with the surgeon's left thumb. From this spot a fold of the stomach is raised obliquely, the upper end of the fold being nearer the cardia and nearer the lesser curvature. This fold is embraced in my stomach clamp, which is applied obliquely, as shewn in the diagram (Fig. 40) the tip of the blades pointing to the patient's right shoulder, the handle to the outer side of the left hip. In the tip of the clamp is the lowest spot on the greater curvature, previously selected. Near the pivot of the clamp is a portion of the

stomach close to the lesser curvature and near to the cardia. The clamp is now placed horizontally by drawing the handle up to the patient's left shoulder.

The portion of jejunum is now selected for the anastomosis. The duodenojejunal flexure is found by sweeping the finger along the under surface of the mesocolon. From this point the jejunum is drawn tight and a spot is selected upon it which reaches to the greater curvature of the stomach while the organ

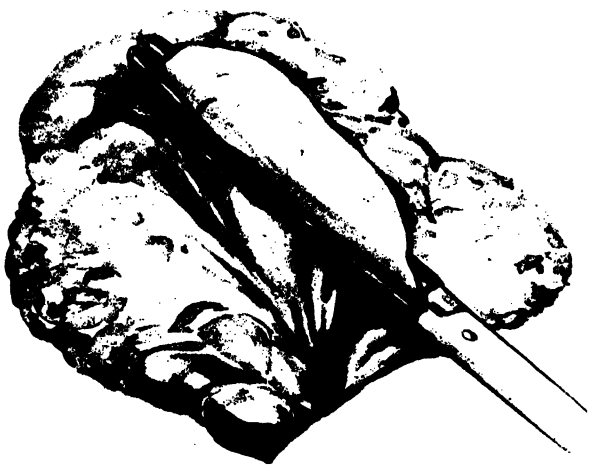


Fig. 40.—The oblique application of the clamp to the stomach.

is in its natural position. This spot is about 5 inches from the flexure; it is the portion of jejunum above it that is now embraced with a clamp, so that when the anastomsis is completed, the greater curvature of the stomach is found to be sutured to the jejunum about five inches from its commencement. The two clamps are now holding the portions of stomach and intestine to be anastomosed. The upper clamp holds a fold of the stomach 3½ to 4 inches in length; the lower, a portion of jejunum of the same length. The portions of stomach, omentum, and transverse colon outside the abdomen are now returned, so that no

viscera remain exposed except those to be engaged in the anastomosis.

The two clamps are now held apart; a roll of moist hot gauze is placed between them; over this they are placed as closely together as possible, and around them hot moist gauze is placed, so that nothing is now visible but the two clamps embracing the viscera about to be united. It is an

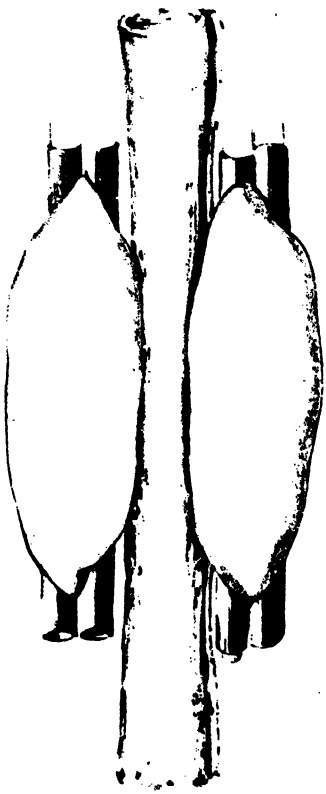


Fig. 41.—Gastro-enterostomy. The strip of gauze between the clamps.

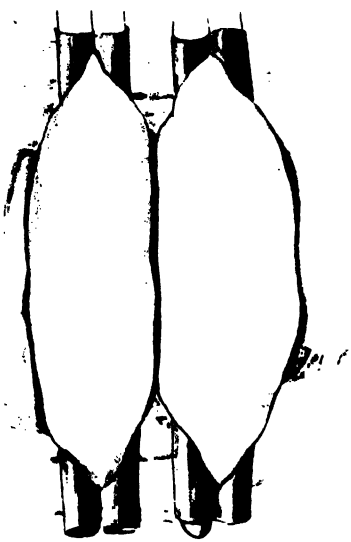


Fig. 42.—The clamps completely surrounded by gauze; all the viscera within the abdomen.

important feature of this operation that there is no undue handling or exposure of any part of the abdominal contents.

The sutures are now introduced; they are all continuous, and there is no interruption by knotting at any part of their course; a needle of my own pattern (made by Down Brothers, London), rather more than half a circle in length and with a rounded body and a slot eye for easy threading, is used, and

thin Pagenstecher (celluloid) thread is employed throughout. The first stitch picks up the serous and muscular coats only. It is commenced at the left end of the portions of stomach and jejunum enclosed in the clamp, and is continued until the greater curvature of the stomach, at the right end of the

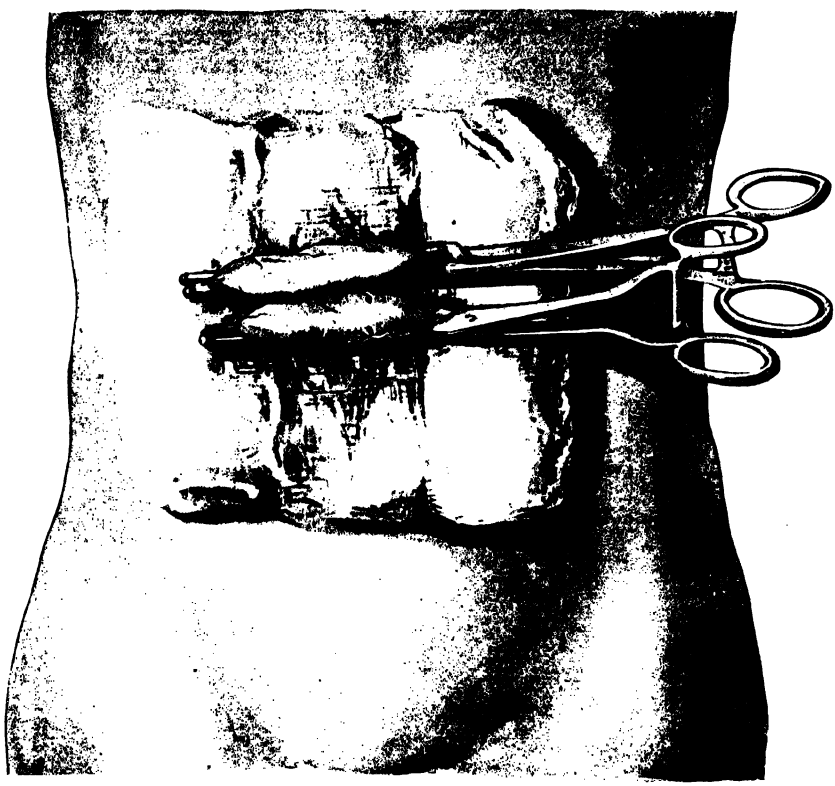


Fig. 43.—Gastro-enterostomy. The clamps in position; the viscera returned within the abdomen; the swabs placed in position. The suture is now commenced. The position of the abdominal wound is faintly indicated.

clamp, is reached. The length of the sutured line should be at least two inches; its average length is between two and three inches. The individual stitches are placed about one-eighth of an inch apart, and the thread is drawn upon sufficiently to ensure an easy approximation of the serous sur-

faces. As each passage of the needle through jejunum and stomach is completed, the suture is pulled upon gently, so that, at the same time, the thread just introduced is tightened and a little ridge or fold of each viscus is raised up, making clear the exact position for the passage of the needle next time. When the first row of the stitch is complete, the needle is

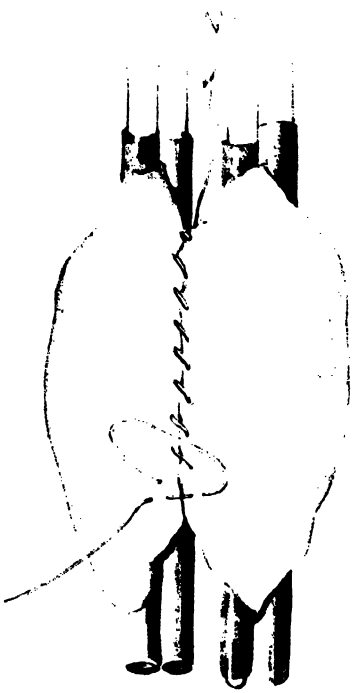


Fig. 44.—The first layer of serous suture.

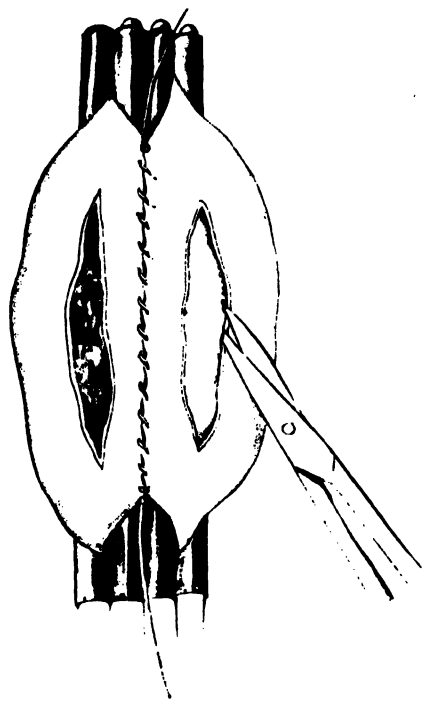


Fig. 45.—Removal of the ellipse of mucous membrane.

laid aside, to be used against a later stage of the operation. In front of this row an incision is now made into the stomach and jejunum, the serous and muscular layers of each being carefully divided until the mucous membrane is reached. As the cut is made the serous coat retracts and the mucous layer pouts into the incision. The cut edge of the serous coat is loosened all around from the underlying mucosa. An ellipse of the

mucous membrane is now excised from both stomach and jejunum, the portion removed being about $1\frac{3}{4}$ to $2\frac{1}{2}$ inches in length, and rather more than half an inch in breadth at the centre. The gastric mucosa shews a marked tendency to retract; it is, therefore, seized with a pair of miniature (French) vulsella on each side. No vessels are ligated, as a rule. The

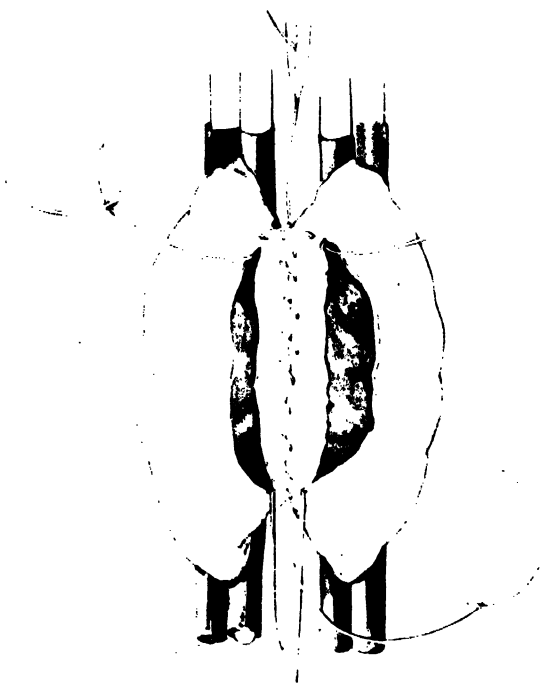


Fig. 46.—The beginning of the suture, which embraces all the coats; Allis's forceps in position.

cut surface of the bowel and stomach may occasionally ooze slightly; this can be checked at once by tightening the clamps one notch. An Allis's forceps is placed on the posterior cut edges of the incision, picking up the mucous and serous coats of the stomach and the serous and mucous coats of the jejunum. It is placed at or near the end of the incision, near the operator, and is allowed to hang down. Its weight is sufficient to keep the cut edges now to be sutured in apposition and to make

them fairly taut. The inner suture is now introduced. It embraces all the coats of the stomach and jejunum around the whole circumference of the opening. The needle is first passed through the wall of the jejunum from the mucous to the serous surface at the left end of the incision, and then from the serous to the mucous surface of the stomach at a corresponding point; the knot, when tied, is on the mucous sur-

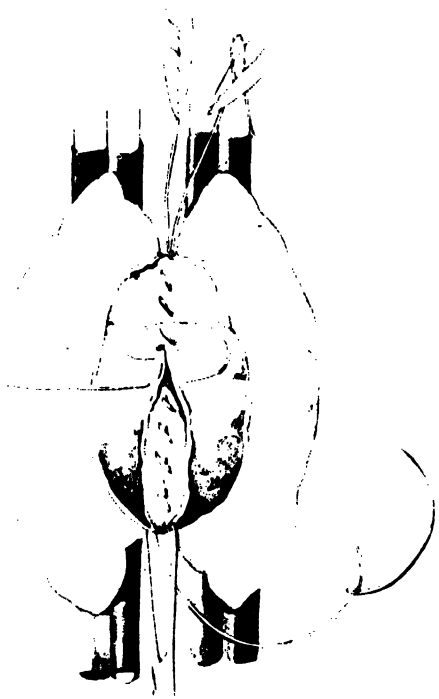


Fig. 47.—The inner suture, continued.

face. The needle is now passed, time after time, from the mucosa of the jejunum to the mucosa of the stomach, picking up both serous coats in its passage. The stitch is drawn tight enough to constrict any vessels in the cut edges, and as it is so drawn the point for the next introduction of the needle is made clear. When the stitch has been completed along the hinder margin of the incision, it is returned along the anterior margin, without interruption until the original end of

the stitch, left long, is reached, when a triple knot is tied and the ends of the suture are cut short.

The clamps are now removed from both stomach and jejunum; the parts are wiped over with hot moist swabs, and all instruments used up to this point are discarded. This is done on the assumption that the mucous membranes of the two viscera may contain micro-organisms. As a matter of fact, organisms are almost invariably absent if the plan of preparation of the patient, elsewhere described, is followed.

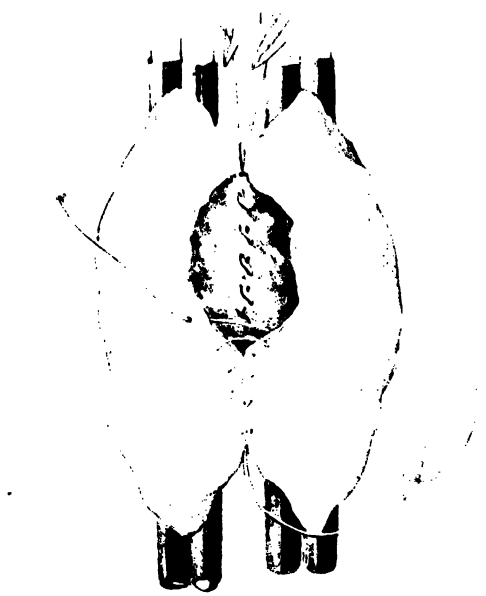


Fig. 48. —The inner suture nearly completed. The mucosa being turned outwards, not inwards.

The original serous suture is now continued. The needle which was laid aside is used again. The only difficult part of the stitch is now encountered, for there are many vessels along the greater curvature of the stomach and near it which have to be avoided, and unless the utmost exactness is observed, a vessel may easily be wounded. If it should be, a deeper and wider stitch must be passed, and tied with sufficient firmness to check the bleeding. The suture is drawn

upon with moderate firmness, with the result that the place for the next introduction of the needle is made plain. When the stitch has been carried around to the point from which it originally started, the end of the thread left long is taken in the fingers; with it the stomach and jejunum are dragged gently upwards, and beyond it the needle is passed once before being tied. This is well shewn in the figure (Fig. 51).

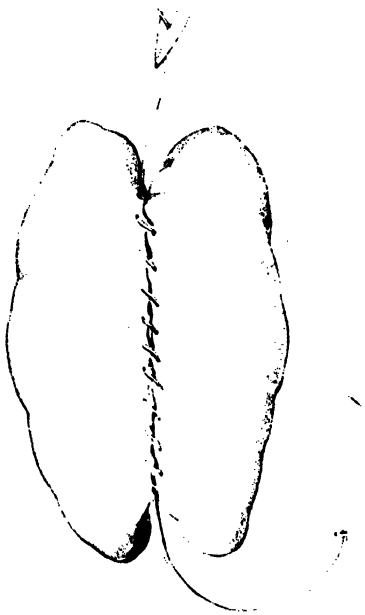


Fig. 49.—The inner suture completed; the clamps removed to shew if there are any bleeding points.



Fig. 50.—The serous suture resumed.

This affords an extra security at a point which might otherwise be weak. The ends of the stitch are knotted and cut short.

The suture lines are now complete. The inner one embraces all the coats and is hæmostatic; the outer one includes the serous and muscular coats, and affords a wide approximation of surfaces.

The stomach and jejunum are now wiped over gently with

hot moist swabs, and the gauze placed around the gut is removed. A strip of gauze, it will be remembered, was placed in between the two viscera before the clamps were brought together. The end of this near the surgeon is now raised up and turned towards the left side of the patient. The result of this is that the under, or opposite, side of the anastomosis is disclosed, and it can then be seen if the suture line is satisfactory. This part also is gently swabbed. If any part of

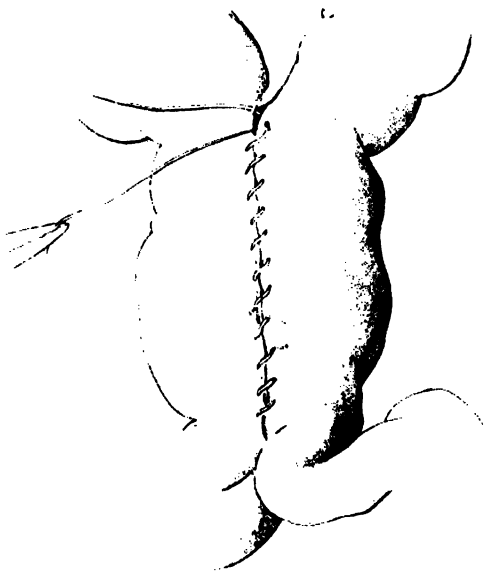


Fig. 51.—Termination of the serous suture; the final stitch overlapping the first one.

the suture line seems weak, a separate stitch may be introduced—this, however, is practically never necessary. The gauze strip is now removed, and the transverse colon and the stomach, which were replaced in the abdomen before the stitching was commenced, are now withdrawn. In the surgeon's left hand the middle of the transverse colon and the lower part of the stomach are grasped, and are drawn gently away from the posterior wall of the abdomen, while, with the right hand,

the portions of viscera at the anastomosis are adjusted in the opening made in the transverse mesocolon. A clip is now placed upon the edges of this opening on the left side, and a suture is passed between this point and the jejunum just outside the line of stitches at the anastomosis. The same is done on the right side, and also at the lowest point (that nearest the transverse colon) of the opening. These three stitches hold the transverse mesocolon in contact with the jejunum all around the line of the sutures. In this manner additional security,



Fig. 52.—The roll of gauze behind the anastomosis when pulled from side to side displays all parts of the suture line.

if such were necessary, would be given to the suture line; and, further, a hernial protrusion of the small intestine into the lesser sac of the peritoneum is prevented. I prefer to stitch the mesocolon to the jejunum rather than to the stomach, as is generally done. The stomach, colon, and omentum are now replaced and the abdominal wound is closed.

I have used the above method in approximately 350 cases of gastro-enterostomy in simple and malignant disease. In only one case have the mechanics of the operation been at fault, and that was in an early case, when no sutures were

passed through the transverse mesocolon. The patient died of a hernia of all his small intestine into the lesser sac. The possibility of this is now prevented by the sutures between the jejunum and mesocolon which I have described.

In all cases of duodenal or pyloric ulcer (especially the former) infolding of the ulcer, as is done in cases of perforation, is desirable. If the ulcer in the duodenum be too large to be infolded



Fig. 53.—The suture line complete. When the stomach and jejunum are held up the latter is seen to descend directly from the flexure on to the stomach, F, in the duodenojejunal flexure. (After W. J. Mayo.)

the gut should be closed by infolding sutures upon the proximal side of it.

It will be seen, from the above description, that the method of suture is precisely the same as that which is adopted in most cases of intestinal anastomosis. The fact that the method is one which is widely applicable is, in my judgment, a very strong point in its favour.

The average time for the performance of the entire opera-

tion is between twenty-five and thirty minutes. I have on three occasions performed it in less than twenty minutes when the circumstances were desperate. There is no method of gastro-enterostomy which is equally rapid and equally safe. In not one case have I seen any fault in the suture line when the abdomen has had to be reopened months or years afterwards for other operations, such as the removal of the appendix or for the performance of ovariotomy or hysterectomy.



Fig. 54.—The same from the other side. (After W. J. Mayo.)

The following are the chief points to be emphasised:

1. When the operation is completed and the parts are being replaced, it will be seen that there is no loop in the jejunum on the proximal side of the anastomosis. The gut descends in a straight line from the flexure to the posterior surface of the stomach. Regurgitant vomiting is therefore unknown; in 200 consecutive cases I have not seen it.

2. The opening in the stomach is oblique. The upper end is nearer the cardiac end than the lower.
3. The opening reaches to the very lowest part of the stomach, on the greater curvature. The formation of a pool of stagnant fluid below the level of the anastomosis is therefore impossible.



Fig. 55.—The final stitches in gastro-enterostomy, uniting the margins of the opening in the transverse mesocolon to the jejunum.

4. The removal of the mucosa of the stomach and jejunum, which results in an *opening*, not a *slit*, being made between the two viscera. For thought of this point I am indebted to the Murphy button, which "stamps out," as it were, a portion of the wall of both stomach and jejunum.
5. The large size of the opening; the smaller opening made

is almost twice the size of that made by the Murphy button or by a bobbin. The size of the opening, moreover, can be justly proportioned to the size of the stomach. A large stomach necessitates a large anastomosis. With all mechanical aids this cannot be done.

6. Absence of undue contraction in the opening results

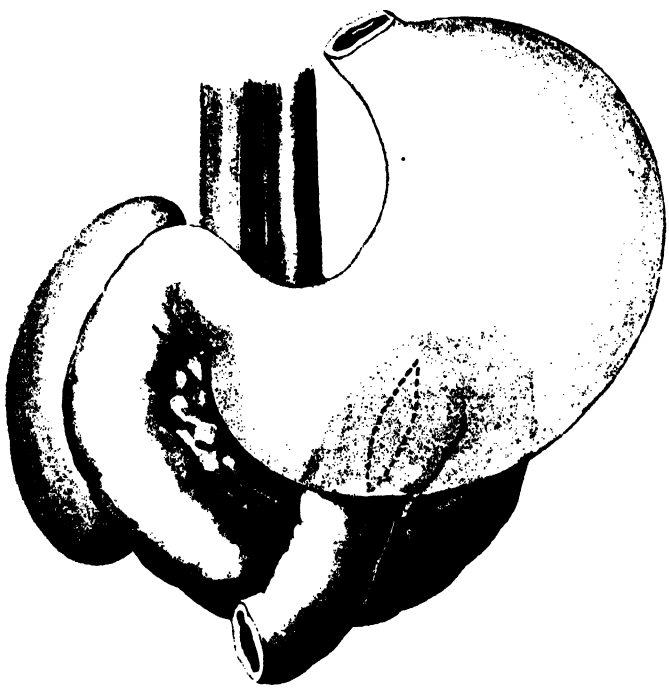


Fig. 56.—Gastro-enterostomy. Shewing the position of the anastomosis on the posterior wall of the stomach. Note the large size of the opening, its obliquity, and the absence of a jejunal loop.

from the close approximation of the cut edges of the mucous membrane of the two viscera. There is, inevitably, in cases of dilated stomach, some subsequent reduction in the size of the anastomosis; this is in direct proportion to the reduction which occurs in the size of the stomach itself. After a gastro-enterostomy

opening has been working for six months in a case of greatly dilated stomach, it will always be found that some reduction in size of the stomach has occurred. The stomach, in my experience, rarely returns to the normal, but a considerable lessening in size is often

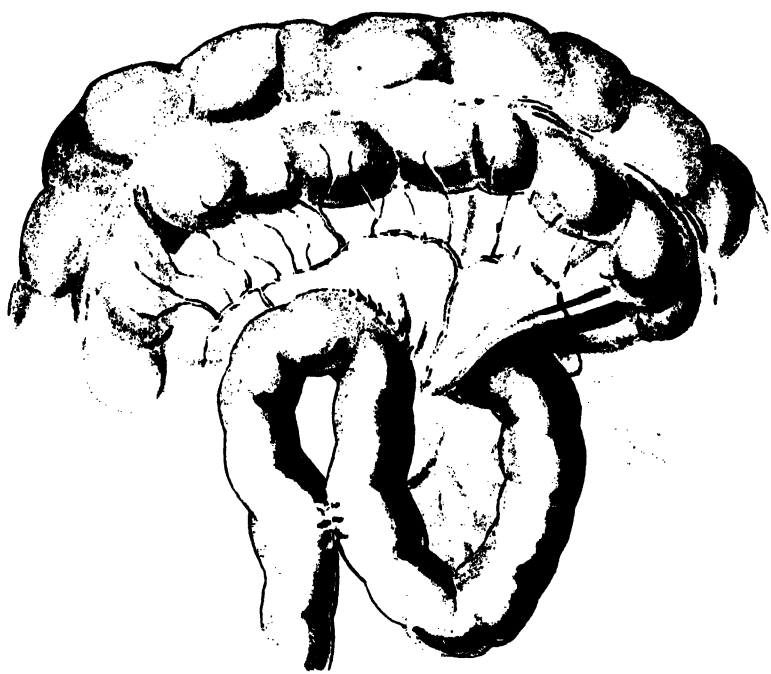


Fig. 57.—Posterior gastro-enterostomy with a loop; entero-anastomosis is also performed.

appreciable. At equal rate does the opening become reduced.

The closure of the anastomotic opening in cases of patent pylorus, described by W. J. Mayo and others, has not occurred in my practice. I have paid especial attention to the point, and in no cases re-examined after the lapse of months or years have I found this closure of the new opening to occur. I am, therefore,

compelled to the belief that such closure is due, not to the patency of the pylorus, but to imperfect methods of performing the anastomosis. In two cases I have had to operate a second time upon patients in whom I found a closure of the gastro-enterostomy opening. In one case I had operated myself, using Laplace's forceps; in the second a colleague had operated and had employed a Murphy button.

It is a common fault in the performance of gastro-enterostomy that the opening is made too small—often far too small. The minimum length of the opening should be 2 inches; and in those cases when the stomach is greatly dilated, it may well be made twice this length.

7. Suture of the transverse mesocolon to the *jejunum*, not to the stomach.
8. The inner suture, embracing, as it does, all the coats, will, if properly applied, prevent any hæmorrhage into the stomach. The suture must be firmly drawn by the surgeon himself: this important matter must not be, as it sometimes is, left to an assistant.

In "Annals of Surgery," April, 1906, page 537, Dr. W. J. Mayo, in discussing the technique of gastro-enterostomy, makes a very important suggestion as to the direction which the line of attachment of the jejunum to the stomach should take. After having made a series of observations upon the direction of the first few inches of the jejunum, he points out that in the operation as above described the gut is made to alter its normal position. From the duodenojejunal flexure the jejunum passes, he says, at once to the left and downwards; when in the operation of gastro-enterostomy it is brought downwards and to the right, along the line I have illustrated above, it is apt to kink either at the flexure or at the point of attachment to the stomach. His suggestion is that the gut should be applied to the stomach so that the opening runs from above downwards and to the left.

He writes:—

"For convenience we will take the origin of the jejunum as being at the point in which the duodenum passes through the transverse mesocolon. The distal end of the duodenum lies behind the stomach when the latter is moderately distended and about one and one-half inches to the left of the middle line and one and one-half to two inches above the umbilicus. Its horseshoe shape has its concavity directed to the left and upward, and its exit is within about two inches as high as the pylorus. The transverse portion of the duodenum passes forward over the prominent vertebral column and backward to the left side of the spine to the opening in the transverse mesocolon. The terminal inch which marks the duodenojejunal juncture is directed upward and to the left, the mesentery of the proximal jejunum lying behind and the free surface of the intestine directed forward. The jejunum from its origin drops at once into the left abdominal fossa. Not only does it pass to the left but it gravitates backward into the left kidney pouch underneath the splenic flexure of the colon, so that at a point four inches from its origin it lies on a plane to the left and posterior. This can be shown in a very practical way by drawing the transverse colon out through the abdominal incision, pulling it upward and to the right until the mesocolon is taut. This brings the beginning of the jejunum into view. It will readily be seen therefore that if the attachment is made to the stomach so that the proximal portion of the gastro-jejunostomy is to the left and above and the distal portion is directed to the right and below, we have introduced two serious displacements. The jejunum no longer falls in the normal manner to the left and backward, but is artificially caused to pass not only to the right but forward, as it must ride the vertebral column or the structures immediately contiguous."

The steps of the operation are as follows:—

"For benign disease the abdomen is opened from three-fourths to one inch to the right of the median line, splitting the fibres of the rectus muscle. The transverse colon is drawn out of the abdominal incision and by a steady traction to the right and upward the mesocolon is brought out until the jejunum comes into view, and the intestine is grasped at a point three or four inches from its origin. On drawing the jejunum tight,

the fold of peritoneum which covers the ligament of Treitz (a small band containing muscle fibres) is developed. This peritoneal band has its origin on the transverse mesocolon and extends down on to the beginning of the jejunum, acting as a suspensory ligament; it will be found to lead to the base of the vascular arch of the middle colic artery, and accurately marks the place where the transverse mesocolon is torn through to



Fig. 58.—Posterior gastro-enterostomy. (Mayo's method.)

secure the posterior wall of the stomach. The stomach is drawn through this opening and the anastomosis performed, beginning at a point one inch above the greater curvature on a line with the longitudinal portion of the lesser curvature and ending at the bottom of the stomach, two and one-half inches to the left. To secure a proper low point a small opening is made in the gastrocolic omentum and one-half inch of the anterior wall pulled through behind. Having these features in view a con-

siderable portion of the posterior wall is drawn into a pair of light elastic curved holding clamps. We prefer the Doyen. The handles lie to the right and about transverse with the axis of the body. Beginning one and one-half to three and one-half inches from its origin the jejunum is drawn into a similar pair of clamps with handles to the right. It will thus be seen that the left low point on the stomach lies in the tip of the clamps and the distal point of the jejunum lies also to the left. By placing the two clamps side by side the operation is completed in the usual manner by two-row suturing, chromic catgut suture being used for the inner through-and-through mucous stitch, as silk or linen may hang ulcerating for months before passing away. In applying this suture on the posterior row behind we use the method advised by Dr. Charles H. Mayo, which consists in entering the needle on the peritoneal side through to the mucous and directly backward from mucous to peritoneum on the same side. By doing this alternately, first on one side and then on the other, with this first chromic catgut suture the peritoneal surfaces are rolled into contact, the parts to be united are held firmly in apposition, and the hæmorrhage is checked. The outer row consists of No. 1 celluloid linen (Pagenstecher), which we have used with great satisfaction since it was introduced for this purpose by Mr. Robson. It is very strong, smooth, and has no capillarity. Flattening the intestine (Cannon and Blake) should be avoided by grasping the intestinal wall close to the margin of the incision with the suture so as to turn in a narrow seam from the intestinal side. On the gastric side, on the contrary, there need be no hesitation in taking a free grasp of the tissues. The rent in the mesocolon is fastened to the suture line with three or four mattress sutures of linen. This should grasp the peritoneal coat close to the margins of the rent in such manner that when tied all the raw surfaces shall be turned in behind the stomach, and the peritoneum folded smoothly against the gastro-jejunostomy opening, so that there shall be nothing to cause adhesions to form between the mesocolon and the jejunum behind the anastomosis."

ANTERIOR GASTRO-ENTEROSTOMY.

The foregoing description applies only to the posterior operation.

If, for any reason, the anterior operation should have to be performed,—for example, on account of adhesions between the posterior surface of the stomach and the pancreas, or of the invasion of the posterior wall by growth, or because the

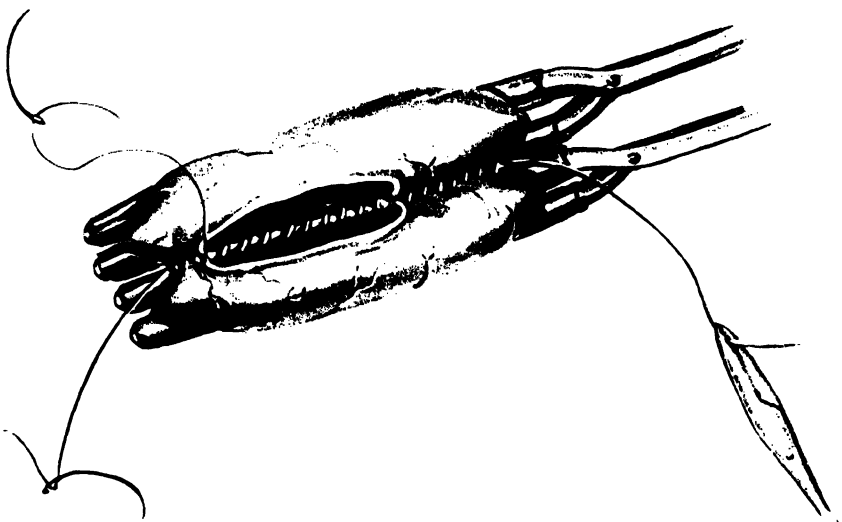


Fig. 59.—Anterior gastro-enterostomy; shewing the outer suture embracing a much longer portion of the stomach and intestine than the inner. The greater curvature is at the left of the picture at the tip of the clamp.

mesocolon is too short,—the same method can be adopted. The only difference is that a point in the jejunum some 15 or 18 inches from the flexure will be chosen for the point of anastomosis, so as to avoid any chance of compressing the transverse colon by an unduly tight proximal loop of jejunum. The oblique application of the clamp and the method of suture are precisely the same as in the posterior method. When the jejunum is fixed to the stomach it is desirable to make its attachment extend well above the opening, so that there is no likeli-

hood of kinking of the gut at the upper end. This may be done by making the outer row of sutures extend over a length of 3 inches, while the opening, 2 inches in length, is kept to the lower end. The figure will explain this point.



Fig. 60.—Anterior gastro-enterostomy; the operation completed. The extension of the outer suture well beyond the upper limit of the opening is seen. The jejunum is represented as transparent so as to shew the position of the opening.

In the anterior operation an entero-anastomosis is perhaps an advantage, though in the few cases in which, in my earlier practice, I adopted this method, I did not make a junction between the two limbs of the loop. An entero-anastomosis may

also be performed after the posterior operation if a loop be left.

In those cases of non-malignant disease in which, for mechanical reasons, the posterior operation would be excessively difficult or impracticable I should myself prefer to perform the anterior operation by Roux's method. In Roux's operation the jejunum is divided completely across about 6 to 9 inches from the flexure; the distal cut end is implanted into the stomach, and an end-to-side anastomosis performed, and the proximal end is implanted into the side of the distal, about 3 inches from its point of union with the stomach. The anastomosis is made between the posterior surface of the stomach and the jejunum, but can be made equally well with the anterior surface. I have twice performed Roux's anterior operation,—the gastro-enterostomy in Y, as it is called,—and the results have been most satisfactory. Indeed, the method is in many respects an ideal one,—it reproduces more nearly the normal conditions, for the bile and pancreatic juice after this operation are introduced into the bowel about 3 inches from the new opening into the stomach, exactly as in the normal duodenum. Roux's operation is said to prevent the possibility of regurgitant vomiting, though I know of one case where the vomiting of bile since the operation has been a constant feature. The disadvantage of the operation is that it requires longer time for its performance, and that in practice the results are not a shade better than, if, indeed, they are as good as, those which follow the ordinary posterior operation.

ROUX'S OPERATION.

I perform Roux's operation in the following manner:

The stomach-wall is clamped as in the ordinary operation. A long loop of jejunum is then picked up, and its base is secured by a clamp. At least 8 or 9 inches should be the length of the loop whose base the clamp holds. The loop embraced by the clamp is now divided about 2 inches from the upper clamped

end, the cut being extended into the mesentery. The upper cut end of the jejunum is now united to the side of the lower part, just above the place where it is clamped; the union is effected in the ordinary manner by suture. The distal cut

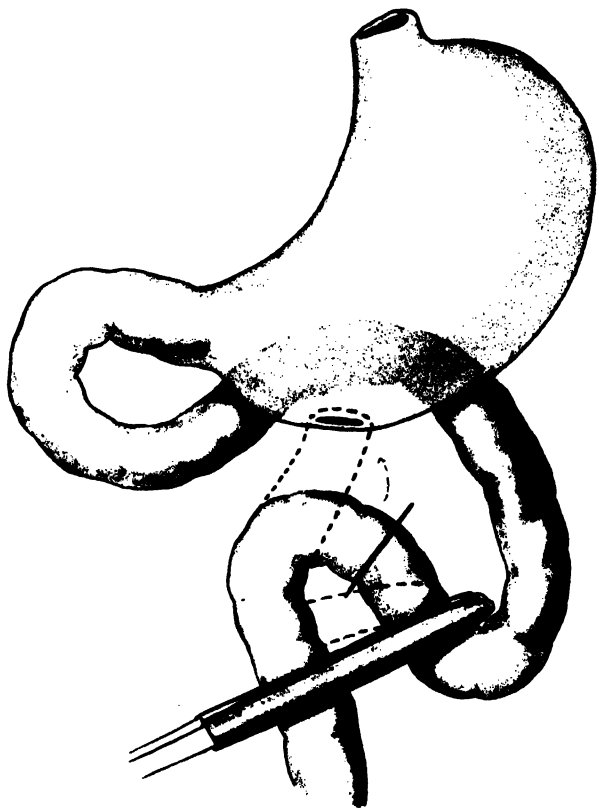


Fig. 61.—Roux's operation. The jejunal loop to be divided is controlled by a clamp which remains on until both anastomoses are complete.

end is then united to the stomach as it is held by the other clamp. The anastomoses are both completed before either clamp is removed. There is consequently no soiling of the operation field by gastric or intestinal discharges or by blood.

The operation takes approximately forty-five minutes—that is, at least fifteen minutes longer than the usual operation.

It is curious to read in many accounts of the great difficulties encountered in the performance of the operation of gastro-enterostomy and of the infinite number of modifications of one sort or another that have been suggested. In this operation, as in all others, the key-note of success is simplicity. The great variety of suggestions as to "new methods," many of

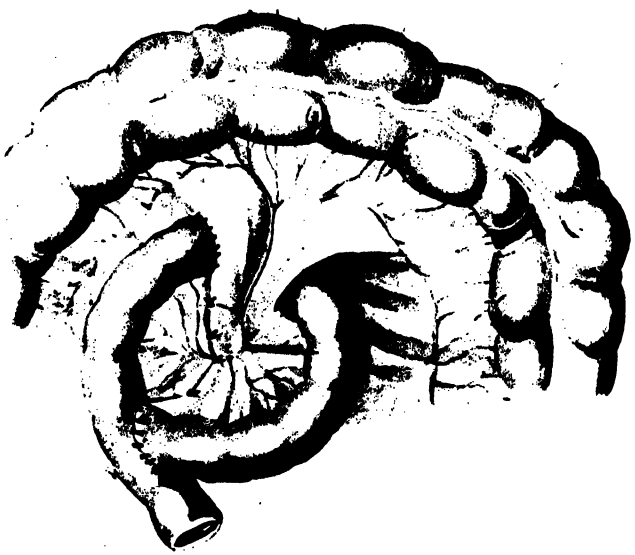


Fig. 62.—Roux's operation complete.

them uncouth, shews beyond doubt that the principles underlying the operation have not been adequately appreciated.

If the posterior operation be performed in the manner described above, the results, both immediate and remote, will, I venture to say, be satisfactory. There will be no need of anxiety as to regurgitant vomiting, nor will there be need or possibility of entero-anastomosis, closures of proximal loops, division of the pylorus, and so forth.

COMPLICATIONS AFTER THE OPERATION.

A number of complications occurring after the operation have been recorded. Among these may be mentioned:

1. Hæmorrhage.
2. Regurgitant vomiting.
3. Internal hernia.
4. Separation of united viscera.



Fig. 63.—Position of a patient in bed immediately after the performance of gastro-enterostomy. As soon as the patient comes round from the anæsthetic he is propped up in this way.

5. Formation of adhesions at or near the point of anastomosis.
6. Peptic ulcer.
7. Chest complications.
8. Diarrhœa.

1. **Hæmorrhage.** There have been recorded at least three deaths from hæmorrhage within a few hours of the completion of the operation of gastro-enterostomy, and in all the blood has been shewn to come from the incision in the stomach.

The bleeding may be due to improper suturing. Unless

ligatures are applied to all the bleeding points in the cut edges of the stomach, the suture must be applied in such a manner as to secure efficient control of the vessels. In two of the fatal cases interrupted sutures were used; this is bad practice. A continuous suture is far more certain to close the cut ends of the vessel; between two interrupted sutures a vessel may bleed unchecked. The best suture is, therefore, a continuous suture which embraces all the coats.

After the inner suture is completed and the clamps are removed, a few moments should be allowed to elapse during which the stomach and intestine are lightly wiped over with a swab wrung out of hot sterile salt solution. This pause in the operation will give time and opportunity to any vessel inadequately controlled to bleed. If a bleeding point is seen, a separate stitch, taking all the coats of both viscera, is passed and is firmly tied.

If the inner suture is applied as I have described, it will be found that the mucosa on the side towards the operator is not turned in towards the lumen, but is turned *outwards;* it therefore remains visible after removal of the clamps, and a bleeding point in it is instantly seen. If the mucosa is turned inwards on this side (the side where the vessels chiefly lie), bleeding may go on unperceived into the stomach. The prevention of hæmorrhage is, therefore, attained by—

(*a*) The use of a continuous suture.
(*b*) The embracing of all coats of the suture.
(*c*) The drawing of the suture firmly and evenly.
(*d*) Inspection of the mucosa after removal of the clamps.

Herczel and a few other writers have recorded cases of death due to hæmorrhage from the ulcer for which gastro-enterostomy had been performed. Unless the origin of the bleeding is demonstrably in the ulcer I should feel disposed to think it more likely that the hæmorrhage had occurred from the incision to the stomach wall. It is necessary in all operations so to handle the stomach as to do as little hurt to it as possible. If bleeding does occur from the ulcer it is probably due to rough handling.

2. **Regurgitant Vomiting.**—Many theories have been put forward to explain the occurrence of regurgitant vomiting after gastro-enterostomy. The formation of a "spur" at the point of anastomosis has undoubtedly some influence, and has been demonstrated by Chlumskij in certain cases operated upon by Mikulicz. It was formerly thought that the sole cause was the presence, in the stomach, of bile and pancreatic juice. Riegel, Malbranc, and Weil related cases where a reflux of bile into the stomach resulted in grave symptoms. Billroth remarked upon the serious import of bile regurgitation after gastro-enterostomy. Claude Bernard and others, founding their opinion upon laboratory experiments, considered that bile inhibited gastric digestion. Dastre, in dogs with gastric fistulæ, introduced bile at all stages of digestion, and concluded that the alkalinising effect of the bile was swiftly negatived by a copious outflow of gastric juice. No ill effects were noticed either on the digestive powers or on the general health. Oddi, experimenting upon dogs, obliterated the common bile-duct and united the gall-bladder to the stomach. All the bile consequently flowed at once into the stomach, with the result that the animals gained in weight and suffered not at all. Max Wickhoff, Angelberger, and Terrier have performed cholecystogastrostomy for obstruction in the common bile-duct, and Perrin ("Thèse de Lyon," 1901) has suggested the routine performance of cholecystogastrostomy in occlusions, presumably complete and irremediable, of the common duct. These records all shew that the mere presence of aseptic bile alone is insufficient to induce vomiting. Chlumskij has suggested that the regurgitant vomiting is due to the presence of pancreatic juice in the stomach. To settle this point, Steudel undertook a series of experiments upon dogs. He divided the intestine completely across at the duodenojejunal flexure, closed the duodenal end, and implanted the jejunal into the anterior wall of the stomach. The dogs lived and thrived for a time, but died from perforation of the duodenal loop by fragments of bone, which had been eaten and had passed from the stomach through the pylorus.

In the "British Medical Journal" of May, 1901, I recorded the case of a boy, aged six, upon whom I performed gastro-enterostomy for complete rupture of the gut at the duodenojejunal

flexure. The torn end of the duodenum was sutured, and, after resection of a few damaged inches, the jejunum was joined to the stomach. As a result, the whole of the bile and the pancreatic juice passed into the stomach. The boy made a perfect recovery, and remained in splendid health until the one hundred and fourth day after the operation. He then became suddenly collapsed and died in a few hours, death being due to the perforation of the bowel by the Murphy button that had been used for the anastomosis. This case proves beyond dispute the ineffectiveness of bile and pancreatic juice as sole agents in producing regurgitant vomiting.

There are four varieties of misdirected current after gastroenterostomy:

1. Regurgitation of duodenal contents through the pylorus.
2. Escape of fluids from the stomach into the afferent loop.
3. Escape of fluids from the afferent loop into the stomach.
4. Regurgitation of the contents of the efferent loop into the stomach.

Any one of these establishes the *circulus vitiosus*. Of these four, the third, the escape of duodenal contents from the afferent loop into the stomach, is generally considered the most frequent and the most grave.

Chlumskij ("Beit. z. klin. Chir.," Bd. xx), in discussing the causes of regurgitant vomiting, suggests the following:

1. Formation of a spur. This is certainly the most frequent. When the anastomosis is effected, the two limbs of the loop hang downwards, and a sharp kink, with spur-formation, results at the point of junction.
2. The jejunal displacement may cause a kink at the duodenojejunal junction, and thereby produce an acute obstruction of the duodenum.
3. The mucous membrane of the stomach may form large pouting valves which obstruct the afferent opening.
4. Closure of the anastomotic opening, if the mucomucous stitch is improperly applied.
5. Compression of the efferent branch of the loop by the colon (Doyen).
6. Steudel related a case, operated upon by Czerny, in which the opening in the transverse mesocolon had narrowed and constricted the efferent loop.

7. In the original operation of Wölfler the antiperistaltic implantation of the jejunum favoured regurgitation.

Of the frequency of regurgitant vomiting, the following figures give some indication: In 65 cases operated upon by Czerny, 1 only presented grave symptoms of regurgitation. An entero-anastomosis was performed, and recovery speedily followed. In 74 cases operated upon by Mikulicz, 7 died of regurgitant vomiting. In 7 cases an entero-anastomosis was performed, and of these, 3 died. In 215 cases of posterior gastro-enterostomy from the Heidelberg clinic, reported later than those of Steudel by Petersen, there was not a single case of reflux vomiting. In 21 cases of anterior gastro-enterostomy an entero-anastomosis was necessary in 3.

A very large number of modifications of the operation of gastro-enterostomy have been suggested, with the hope of preventing reflux. In Wölfler's original operation, performed September 28, 1881, the jejunum was united to the stomach with its proximal end nearest to the pylorus. Von Hacker, in 1885, suggested that the jejunal anastomosis should be made, not on the anterior, but on the posterior, surface of the stomach, which could be reached by tearing through the transverse mesocolon. The point on the jejunum to be utilised for the anastomosis was placed by von Hacker 20 to 25 centimetres from the duodenojejunal flexure; by Kappeler, 40 to 60 centimetres; by Chlumskij, 50 centimetres; by Kader, 60 to 80 centimetres. Petersen emphasised the importance of the anastomosis being as near to the flexure as possible. In 1883 Courvoisier performed a "gastro-enterostomie rétrocolique postérieure transmésocolique," an operation attended by no satisfactory results, but memorable as containing the germ of the idea which von Hacker utilised in his method. In 1892 Jaboulay suggested, and in 1894 performed, the operation of gastroduodenostomy; Kümmell, in 1895, independently suggested the same procedure. Mikulicz and Villard strongly commend the method. Kümmell divided the duodenum completely, closed the proximal end, and implanted the distal into the stomach. Jaboulay united the anterior wall of the duodenum to the anterior wall of the stomach, folding the duodenum forwards over a hinge formed by the pylorus. Villard described his method under the title "gastro-duodénostomie sous-pylorique." Instead of folding the

duodenum over on to the stomach, he anastomosed the adjacent surfaces of the stomach and duodenum. Brenner introduced a retrocolic, anterior gastro-enterostomy. A loop of the jejunum was passed through a rent in the transverse mesocolon, and then pulled forwards through the omentum just below the greater curvature of the stomach, and united to the anterior wall.

In 1887 Rockwitz drew attention to the fact that in the operation of Wölfler the current in the stomach was opposite in direction to that in the duodenum. To ensure an isoperistalsis he suggested that the proximal end of the loop should be fixed towards the cardiac end and the distal towards the pyloric end of the stomach. In 1898 Roux, of Lausanne, performed his method of "gastro-enterostomy in Y," adapting to this operation a method that had been practised in 1892 by Maydl for jejunostomy. Roux divided the jejunum completely across, implanted the distal end into the stomach and the proximal into the side of the distal.

The operation of entero-anastomosis was first suggested in 1890 by Lauenstein, who advised that the afferent loop should be united to a neighbouring coil of intestine. In 1892 Braun and Jaboulay performed entero-anastomosis between the afferent and efferent loops. Doyen performs a gastro-enterostomy in Y which is similar to that adopted by Roux, but is anterior instead of posterior, and the approximations are made side to side and not end to side. His method is considered by Lücke to be the best of any method yet suggested. It is practically a gastro-enterostomy, an entero-enterostomy, and a resection of the afferent loop combined.

Several methods of narrowing the afferent loop with the hope of preventing its filling with stomach-contents have been suggested. Wölfler surrounds it with a circular stitch; Chaput packs round it with iodoform gauze; and von Hacker makes a series of longitudinal pleats in it. Tavel has shewn that in his patient after a few weeks no trace of a fold could be discovered.

Several methods of preventing misdirection of the stomach have been carried out; the methods are usually described as "gastro-enterostomy by invagination." Faure invaginates a cone of the stomach into the distal segment of the anastomosed loop. Sonnenburg sutures the edges of the stomach incision,

leaves the threads long, passes them into the jejunum at the opening for the anastomosis, and out by a second opening a couple of inches distal to this. By drawing now upon the sutures the stomach is pulled well into the jejunum. Rutkowsky, Witzel, and Kader have combined the operations of gastro-enterostomy and jejunostomy, passing the tube into the stomach and through the gastro-enterostomy opening into the distal segment of the duodenum.

The attempted formation of a valve at the new opening, suggested by Wölfler in 1883, has been carried out most effectively by Kocher, who makes a semilunar incision in both stomach and intestine, the convexity being upwards.

Hadra, in 1891, was the first to suggest that the loop of the bowel united to the stomach should be attached to it both above and below the opening, so that it should be suspended from the stomach by a wide attachment. In this manner the formation of a spur would be effectually prevented. Lauenstein, in 1896, suggested the suspension of the gut only on its proximal side.

The whole question as to regurgitant vomiting has, however, receded into the background in my experience. I never see it in any case of mine now, nor have I seen it in the last 130 cases. I believe regurgitant vomiting to be due solely to a mechanical defect in the operation, a defect which consists mainly, if not solely, in the leaving of a loop of jejunum between the flexure and the anastomosis. This loop becomes "water-logged": the bile and pancreatic juice distend it, being unable to escape from it easily into the distal limb. Regurgitation through the pylorus then occurs; or the weight of the heavy loop causes a kink at the anastomosis which closes the entrance to the distal limb.

Treatment.—The treatment of regurgitant vomiting in the serious cases must be by operation; an entero-anastomosis must be performed. In the slighter cases relief is often afforded in a remarkable manner by lavage of the stomach every twenty-four hours for a few days.

3. **Internal Hernia.**—Several cases of internal hernia following gastro-enterostomy are recorded; some of these have proved fatal, some have been remedied by subsequent operation.

One of my own cases proved fatal. The following are the notes:

The patient, a male aged twenty-eight, was seen on October 30, 1902. For fourteen months he had suffered from indigestion. At the onset he had an acute attack of indigestion lasting five days; occasional vomiting then, but no blood. He fainted several times, and had tarry motions. During the last three months he had become progressively worse, and lost over a stone in weight; had constant pain after food and occasional vomiting. He could take only fluids, and was "wearing down" fast. The stomach was moderately dilated. Free HCl present. Old blood was noticed in the stools in infirmary almost daily. At the operation duodenal and gastric ulcers were found; duodenal ulcer in first portion about the size of a threepenny-piece, very hard, and slightly adherent. A scar was found on the posterior surface of the stomach near the pylorus. The patient died on the tenth day of acute intestinal obstruction. At the postmortem examination it was found that there had been a hernia of almost the whole of the small intestine through the rent made in the transverse colon, and that the herniated bowel was tightly strangled at the opening.

Dr. W. J. Mayo has recorded ("Annals of Surgery," August, 1902) a case; the following is an extract from his description:

"Abdomen re-opened. Gastrojejunal orifice nearly obliterated and stretched to an inch in length. Jejunum twisted at the site of anastomosis one-half turn from the left to the right. Somewhat more than one-half of the small intestine had passed through the loop of jejunum, between the origin of the jejunum and the attachment to the stomach. The point of entrance was on the right side, beneath the transverse colon. The traction weight of the intestines upon the mesentery at the inferior margin of the loop had caused the volvulus. The mesentery at this point was much thickened; the intestines were replaced, the gastrojejunal fistula divided, and the opening into the stomach closed. The opening into the jejunum was enclosed by a purse-string suture, and the half of a Murphy button was introduced and a posterior gastrojejunostomy made. The pyloric stricture was nearly complete, the ulcer evidently cicatrised. It is probable that the part of jejunum immediately below the anastomosis passed through the loop first, producing the

twist which was so prominent a feature on opening the abdomen. As to when this happened, it is hard to tell—probably not for some months after the operation. When the process once began, it might be expected to continue until such an amount of intestine travelled over the loop as to pull the mesentery taut, the symptoms increasing as the condition gradually developed. It is possible that at the time the juncture was effected a slight twist might have occurred.

A similar case is recorded by Dr. Gray, of Aberdeen ("Lancet," vol. ii, 1904, p. 526):

The patient, an unmarried woman, aged thirty-one years, was seen by me in consultation on the evening of May 15, 1904. For some months she had suffered from severe "indigestion," intense epigastric pain, radiating to the back, occurring almost immediately after taking food. She had not vomited during this period, but had noticed that the stools were very dark on several occasions. On May 14 she became suddenly collapsed and vomited a large quantity of blood. In spite of medical treatment the hæmatemesis was repeated several times, although not to such a large extent. The bowels were opened and the stool contained a large quantity of blood. On the evening of the fifteenth she became again so collapsed that death was thought to be imminent. She had recovered somewhat before I saw her. Her pulse was very feeble and irregular. It was occasionally as low as 120, but was usually considerably quicker. It was estimated that she had vomited between two and three pints of blood. By percussion of the shifting dulness, limited to the gastric area, it was found that the stomach contained at least a pint of blood. Nothing had been given by the mouth since the onset of the attack. These facts, considered along with the presence of the large quantity of blood in the stool, made the total blood lost amount to probably between four and five pints. It seemed that the bleeding had stopped and it was thought advisable to wait until the morning, as transference to hospital would have had a severe effect on the patient in her perilous condition. Morphine was given hypodermically and a careful watch was set. She passed a fairly good night, but early the next morning she again vomited blood and was removed to hospital. On arrival there she vomited a small quantity of fresh blood, so an operation was carried out at once.

Chloroform was administered, and three pints of saline solution were slowly infused into a vein at the elbow. The stomach was exposed by a free incision. Blood was seen to be present in large amount in the stomach and in the whole length of the intestines. Nothing else abnormal about the stomach was detected by inspection or palpation. The blood was squeezed through the pylorus, the stomach was opened posteriorly, and its interior was inspected. No ulcer was seen. A posterior retrocolic gastro-enterostomy was performed. Sutures alone were used.

The patient vomited early on the second day after operation. The vomit contained a small amount of "coffee-ground" material and was foul smelling. Five minims of liquid extract of cascara sagrada were given every hour, but after three doses she became sick, so it was intermitted for twelve hours and then begun again. An enema was given on the evening of the day of operation to clear the rectum; a tarry motion resulted. Every second day thereafter an enema was administered. On the fourth day the stool was free from blood.

About noon on the sixth day she complained of intermittent griping pain in the abdomen. This continued until the evening, when it abated somewhat. It was thought probably to be due to flatus, although previously to this a turpentine enema brought away neither flatus nor fæces. A small dose of morphine was given. She was quite comfortable until 3 o'clock on the morning of the seventh day, when the pains began again and increased in severity as the effect of the morphine passed off. Vomiting occurred on two occasions. At 9 A. M. another turpentine enema was given, but with no result. The facial expression was now somewhat drawn and anxious. Vomiting continued at intervals, but the pains subsided considerably after the enema. The temperature and the pulse were unaffected. The latter had become reduced in frequency from 144 on the day of operation to 100 to 110.

Intestinal obstruction was diagnosed, and immediate operation was advised. This was declined. I prescribed two drachms of magnesium sulphate by the mouth and eight minims of liquor strychninæ hypodermically. The immediate effect of this was to produce severe colicky pain and acquiescence in operation, which was carried out at 4 P. M. It was then found that prac-

tically the whole of the small intestine had insinuated itself from left to right through the ring formed at the first operation by the peritoneum of the under layer of the mesocolon, that lining the posterior abdominal wall and forming the upper layer of the mesentery, and completed anteriorly by the gastrojejunal junction. It was easily pulled back and the ring closed by suturing the under layer of the mesentery to prevent recurrence of the hernia. Strangely enough, there was enormous distension of the colon with gas. It was found to be quite patent down to the rectum. It was accordingly punctured by a trocar and canula and the gas let out. A silk suture was inserted to close the opening made by the trocar, and a piece of omentum was stitched over that. The gastrojejunal junction was found to be perfect. The patient vomited once during the evening after operation, but thereafter recovery was uninterrupted, and she left the hospital on June 13. She was seen on July 5, when she looked extraordinarily well. She had suffered no pain, no indigestion, and no vomiting since her dismissal. The stools had been normal. She now made no restrictions in her diet.

A case is also recorded by Mr. Barker:

Under chloroform an incision was made in the middle line below the umbilicus. Slipping the finger in under the scar, not a trace of adhesion to it could be found. The wound was then enlarged upwards through the old scar, which was perfectly firm. Some free ascitic fluid now ran out, and dark, distended coils of small intestine presented on both sides. The transverse colon was sought for and drawn out and was found to be pale and much contracted. Search was then made for the gastro-enterostomy junction, but it could not be clearly made out. With the finger I could feel the plica duodenojejunalis at the root of the left side of the mesocolon, but the direction of the first part of the jejunum was not clear. On the right side of the middle of the mesocolon small intestine was felt passing under some tightly constricting mass, and on drawing the coils aside the last seven or eight inches of the ileum, tense and contracted to the size of the little finger, were seen ending in the normal cæcum and twisted on its own axis. Following this back it was seen to pass behind the gastro-enterostomy junction and to be twisted on itself at the point of constric-

tion. It was now plain to all present that the whole of the small intestine with the exception of the last seven inches or so had passed between the junction of the stomach and jejunum and the root of the mesocolon made two years ago, and over the first part of the jejunum (A) (afferent), and then down into the gen-

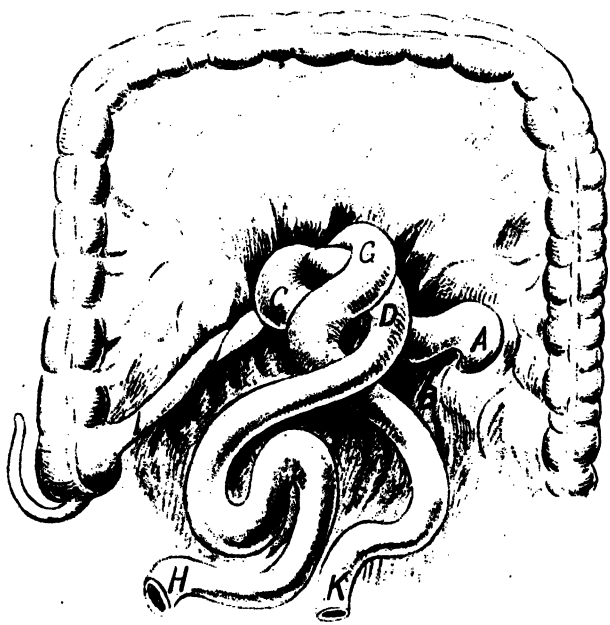


Fig. 64.—A, Afferent jejunum coming out from under the plica duodeno-jejunalis (B); C, termination of the afferent duodenum dragged back to the hidden anastomosis, from which (D) the efferent jejunum is passing in its turn over the afferent portion (A to C); G, last part of the ileum twisted round the efferent jejunum and terminating in (I) the end of the ileum at the ileocæcal valve; H, distended coils of the jejunum in the general cavity of the abdomen; K, coils of the ileum in the general cavity of the abdomen. It is seen from this diagram that the *whole* of the small intestine with the exception of the first and last seven or eight inches passed behind the gastro-enterostomy junction and was strangulated over the afferent portion, where it formed a large volvulus (Barker).

eral cavity of the peritoneum. But not only this, the whole small intestine having thus passed, formed a huge volvulus, turning on its mesentery in a direction contrary to the movements of a clock. When this was recognised, the coils as a whole were lifted up and untwisted one complete turn in the direc-

tion of the movements of the hands of a clock. Only then could the last part of the ileum (1) be withdrawn from under the constriction, all previous efforts in this direction having failed. But when the volvulus was untwisted, it, and all the rest of the small intestine above it, could be easily and rapidly drawn out. The junction with the stomach could now be plainly seen, and both the afferent and efferent loops; the coils were washed with normal saline solution (warm) and the abdomen was closed. The operation lasted sixty-five minutes and was well borne. Convalescence was uninterrupted and primary union was found when the stitches were removed on the eighth day.

A case of internal strangulation following gastro-enterostomy was related before the Royal Academy of Medicine in Ireland by Mr. Gordon ("Lancet," 1905, vol. ii, p. 1477). A loop of the bowel had passed from right to left above the proximal loop of the jejunum, there becoming strangulated. A second operation was necessary to relieve the obstruction, and was successful.

In addition, a case of my own has been operated upon a second time, and a hernia through the opening in the transverse mesocolon discovered.

All the forms of hernia can be prevented by attention to two points:

(*a*) The suture of the edges of the opening in the mesocolon to the stomach, or, preferably, to the jejunum.

(*b*) The avoidance of a loop of jejunum between the duodenojejunal flexure and the anastomosis.

4. **Separation of the united viscera** has occurred only after the use of mechanical appliances, and as these are no longer necessary, this complication is negligible. With the suture it does not occur.

5. **The formation of adhesions** around and about the anastomosis is very rarely seen. As a result of them, a constriction of the jejunum may result, and vomiting, due to high intestinal obstruction, will occur. I once operated upon a patient, upon whom gastro-enterostomy had been performed by another surgeon, on account of persistent vomiting. The distal loop of the jejunum was buried in dense adhesions, which reduced the calibre of the bowel to approximately a quarter of its former size. The proximal loop was greatly distended.

A somewhat similar case is recorded by F. B. Lund ("Boston Med. and Surg. Journal," May 11, 1905, p. 549).

It is not improbable that the tendency to the formation of adhesions is due to infection at the time of operation.

6. **Ulcer of the Jejunum.**—During the last few years attention has been drawn to the occurrence of "peptic" ulceration in the jejunum after the performance of gastro-enterostomy. Two valuable papers have recently dealt with this subject in considerable detail—Tiegel ("Mitth. a. d. Grenzgebiet," 1905, vol. xiii, page 897) and Gosset ("Rev. de Chir.," 1906, p. 54).

Tiegel analyses the records of 22 cases, Gosset of 9 additional cases; Battle ("Lancet," vol. i, 1906, page 275) has since recorded 2 cases, making 33 in all. Of these, 30 occurred in men, 3 in women. The ulcer is found in the jejunum distal, always, to the anastomosis. As a rule, one ulcer only is found (in 30 cases) but in one case four ulcers were present. In one case the ulcer was found close to the point where an entero-anastomosis had been performed. Pathologically and etiologically the peptic ulcer in the jejunum exactly corresponds to the similar ulcer found in the duodenum.

The nature of the operation performed is mentioned in 29 instances:

In 17 cases it had been anterior gastro-enterostomy.
In 4 cases it had been anterior gastro-enterostomy with entero-anastomosis.
In 1 case it had been gastro-enterostomy in Y.
In 6 cases it had been posterior gastro-enterostomy. In all, a long loop had been left.
In 1 case it had been gastro-enterostomy with entero-anastomosis.

The time which elapsed between the performance of the gastro-enterostomy and the discovery of the peptic ulcer has varied from ten days to nine years.

The clinical forms in which the symptoms may appear are three:

1. The symptoms are the same as those of duodenal ulcer; pain some time after food, burning, flatulent distension, hyperacidity.

2. Acute perforation occurs without inaugural symptoms.

3. The symptoms recur, and a "subacute" perforation occurs; there is an abundant localised plastic peritonitis, and a lump may be felt in the epigastrium.

The two latter forms are described by Tiegel, but I have seen one case, as yet unrecorded, of the first type. It is not improbable that in some of the cases where operation is supposed not to have relieved the original condition of duodenal or pyloric ulcer, the symptoms may in reality be due to secondary peptic ulceration in the jejunum.

So far as the causes are concerned, hyperacidity would seem to be the most frequent. It was noticed in 18 of the 33 cases; in the majority of the 15 remaining cases no observations upon this point were made. Gosset asserts that three factors are at work,—hyperacidity, tight stenosis of the pylorus, and great dilatation of the stomach. These, I think, are only the conditions usually present when gastro-enterostomy is performed. They are factors necessitating operation in the first instance, but can hardly be supposed to have any causative influence in producing a peptic ulcer. A fourth cause which was mentioned by Prof. Garré at the discussion at the first meeting of the International Surgical Society was want of accurate apposition of the mucous edges at the time of operation. A raw surface is left which allows of easy digestion by the hyperacid gastric juice. This probably accounts for some cases, but in the majority of cases the ulcer is not exactly at the opening, but an inch or more away.

In the series there were three cases in which fistulæ had formed between the jejunum and the colon.

In several of the cases it was noticed that local swelling (generally to the left side of the epigastrium) was present. In some of these active peristalsis of a much distended coil of bowel was seen. This occurred when an anterior gastro-enterostomy had been performed; it was due to the distension of the coil of jejunum between the flexure and the anastomosis. Owing to the plastic peritonitis around the perforation, an acute intestinal obstruction had been caused at this high point in the bowel.

Treatment.—If the ulcer gives way, the case must be treated as one of perforating gastric or duodenal ulcer by instant operation.

In those cases where plastic peritonitis was present operation has not been attended by much success. The best record of a case of this kind is given by Mayo Robson, and as his plan of treatment seems to me the best yet suggested I give a brief account of his case.

The patient was a man, aged forty-four, upon whom gastro-enterostomy was performed in January, 1900:

"The patient remained well for two years, had neither pain after food nor vomiting. He gained his normal weight, and was able to do his work. After this, he began to have pain at the epigastrium. The pain seemed to bear no relation to food, and was unaccompanied by vomiting. There was marked tenderness at the epigastrium, especially on the left of the middle line. At times the pain was so acute at to cause him to roll on the floor and to perspire profusely. At first the attacks were not very frequent, only coming on at intervals of a month or two, but recently they had been more frequent, almost daily, and during the week before we saw him, dark blood had been noticed in the motions on several occasions. He was sent by Dr. James Hall, on May 5, 1903, when a well-marked tumour was found occupying the epigastrium, and decidedly tender to pressure; but there was no vomiting and no sign of stomach dilatation could be discovered. Tarry matter was seen in the motions.

"The diagnosis of thickening around a chronic ulcer and perigastritis was made, and an exploratory operation advised. The abdomen was opened by an incision just to the right of the middle line, and the stomach was found adherent to the anterior abdominal wall, one inch to the left of the old scar. On separating the adhesions, it was found that ulceration had occurred at the point of junction between the bowel and the stomach, and that it had involved the whole circumference of the jejunum at that point, the ulceration having completely extended through the intestinal wall at the front; but this must have occurred after adhesion, so that there had been no acute symptoms of perforation. Through the opening left when the

adhesions had been separated the finger was passed into the stomach, when it was found that the pylorus had quite closed as a result of the ulceration three years before, so that nothing could be passed through it. On passing the finger into the intestine, extensive ulceration and thickening were discovered. The ulcerated portion of the bowel was completely excised, and then separated from the opening in the stomach, the edges of which were pared; the distal end of the jejunal loop was implanted into the old opening in the stomach, the union being effected over a bone bobbin. The proximal end was implanted into the jejunum about 4 inches lower. This union was also effected over a bone bobbin."

It is important for us to consider, in the performance of the primary operation, the possibility of avoiding the risk of peptic ulcer. Goepel has suggested that the anastomosis should always be made nearer to the cardia than is now customary, that what he terms "gastro-enterostomia fondosa" should be performed.

This suggestion is not, in my judgment, a practicable one. What I believe to be necessary is that the opening in the jejunum should be made, as I have described above, as near the flexure as possible. It is not improbable that the greater frequency of the condition after anterior, as compared with posterior, gastro-enterostomy is due to the lessened power to withstand acid contact possessed by the mucous membrane at a lower point in the intestine.

A very important point, also, is to ensure that in all cases where hyperchlorhydria is present, a preliminary treatment with alkalies shall be carried out, and that after operation greater care than usual shall be exercised in matters of diet for at least a few months. The voracity which many of the patients exhibit in their swift rebound into health should be controlled. Plain, simple foods, in moderate quantities, should be given, and bismuth and alkalies administered if there be any distress after food. The toilet of the mouth, moreover, should not be forgotten.

The following table is copied almost entirely from Gosset. A few additional particulars have been obtained, and two cases have been added.

TABLE OF RECORDED CASES OF PEPTIC ULCER IN THE JEJUNUM.

No.	Reference.	Sex and Age.	Operation for	Gastric Acidity.	Type of Gastro-enterostomy.	Time After Operation.	Lesions Found.	Treatment.	Result.
1	Braun, 1899.	Male; 25.	Indurated stenosis of pylorus; great dilatation.	Normal.	Posterior.	11 mos.	One ulcer in descending loop; 1 cent. below gastro-enterostoma. Perforation, peritonitis.	No operation.	Died.
2	Hahn, 1899.	Male; ?	Pyloric stenosis.	?	Anterior.	12 mos.	1 ulcer in descending loop, ½ cent. below the stoma. Perforation; peritonitis.	No operation.	Died.
3	Mikulicz-Kausch-Tietze, 1899.	Male; 32.	Stenosis; stomach very dilated.	+	Anterior.	16 mos.	1 ulcer at the level of the anastomosis. Ulcer adherent to abdominal wall.	5 operations. and finally gastrostomy.	Recovered.
4	Körte, 1900.	Male; 30.	Stenosis; stomach very dilated.	+	Anterior.	3 yrs.	Perforation, peritonitis.	Laparotomy.	Died.
5	Steinthal, 1900.	Male; 44.	Pyloric stenosis.	?	Posterior, with Murphy's button.	10 days.	4 ulcers; 2 in ascending, 2 in descending loop. Perforation, peritonitis.	No operation.	Died.
6	Mikulicz-Kausch, 1901.	Male; 25.	Pyloric stenosis; stomach very large.	+	Anterior, with entero-anastomosis.	18 mos.	1 ulcer in ascend. loop adherent to abdominal wall.	Excision of ulcer and suture. Jejunostomy of the ascending limb.	Recovered.

7	Quénu, 1902.	Male; 29.	Pyloric stenosis and enormous dilatation of stomach.	+	Anterior, with button.	4 yrs.	1 ulcer adherent to abdominal wall.	Resection of the ulcerated loop and gastrojejunostomy in "Y."	Recovered.
8	Kocher, 1902.	Male; ?	Pyloric ulcer.	—	In "Y"	1 yr.	1 ulcer adherent to abdominal wall.	Excision.	Recovered.
9	Heidenhain, 1902.	Male, middle aged.	Stenosis with bleeding ulcer	?	Anterior.	? mos.	1 ulcer at the anastomosis.	Suture. Relapse some mos. later; laparotomy; suture of an ulcer and fresh gastro-enterostomy.	Recovered.
10	Goepel, 1902.	Male; ?	Stenosis with dilatation.	+	Anterior.	13 mos.	1 ulcer, 2–3 cent. from stoma. Perforation, peritonitis.		Died.
11	Goepel, 1902.	Male; ?	Stenosis with dilatation.	+	Anterior.	4 mos.	Perforation, peritonitis.	Immediate operation.	Recovered.
12	Goepel, 1902.	Male; 34.	Stenosis with dilatation.	+	Anterior.	9 mos.	Perforation, peritonitis.	Immediate operation.	Recovered.
13	Krönlein, 1902.	Male; ?	Duodenal ulcer with induration of head of pancreas.	?	?	4 yrs.	1 ulcer adherent to abdominal wall.	Excision.	Recovered.
14	Mikulicz-Kausch, 1902.	Female; 2 mos.	Congenital stenosis.	+	Anterior, with entero-anastomosis.	3 mos.	Perforation, peritonitis.	No operation.	Died.
15	Hahn, 1902.	?	?	?	Anterior.	?	1 ulcer adherent to abdominal wall.		Recovered.
16	Hahn, 1902.	Male; ?	?	?	Anterior.	?	Ulcer adherent to parietes.		Recovered.
17	Czerny, 1902.	Male; 59	Pyloric stenosis.	+	Posterior.	9 yrs.	Ulcer at level of anastomosis.	Excision.	Died.

TABLE OF RECORDED CASES OF PEPTIC ULCER IN THE JEJUNUM—(Continued).

No.	Reference.	Sex and Age.	Operation for	Gastric Acidity.	Type of Gastro-Enterostomy.	Time After Operation.	Lesions Found.	Treatment.	Result
18	Czerny, 1902.	Male; 42.	Pyloric stenosis.	Normal.	Posterior, with button.	6 mos.	Ulcer at level of anastomosis.	Gastro-enteroplasty, and some mos. later Billroth's first method.	Died.
19	Czerny, 1902.	Male; 36.	Ulceration with dilatation.	+	Posterior, with button.	2 yrs.	1 ulcer with gastro-colic fistula.	Closure of colon and fresh gastro-enterostomy.	Recovered.
20	Neumann, 1902.	Male; 24.	Stenosis with great dilatation.	+	Anterior; vicious circle and subsequent entero-anastomosis.	13 mos.	Ulcer adherent to abdominal wall.	Three operations.	Recovered.
21	Mikulicz-Tiegel, 1903.	Male; 53.	Stenosis	+	Anterior, with entero-anastomosis.	4 yrs. 4 mos.	Ulcer adherent to parietes.	Suture of ulcer.	Died.
22	Mikulicz-Tiegel, 1903.	Male; 33.	Ulcer.	+	Anterior, with entero-anastomosis.	3 yrs. 2 mos.	Ulcer adherent to parietes.	Separation and suture.	Recovered
23	Brodnitz, 1903.	Male; 58.	Stenosis with dilatation.	+	Anterior.	3 yrs. 9 mos.	2 ulcers, in jejunum and at anastomosis.	Resection of anastomosis and new gastro-enterostomy.	Recovered.
24	Schlaffer, 1903.	Female; 33.	Pyloric ulcer.	?	?	?	Peptic ulcer at the level of anastomosis.	New gastro-enterostomy, then a second operation.	Recovered.
25	Mayo Robson, 1904.	Male; 44.	Gastric ulcer with hæmatemesis.	+	Anterior with bobbin.	3 yrs. 4 mos.	Ulcer adherent.	Enterectomy; gastro-enterostomy in "Y."	Recovered.

26	Tiegel, 1904.	Male;	41.	Stenosis with dilatation.	+	Anterior.	2 yrs.	?	Medical treatment.	Recovered.
27	Kaufmann, 1905.	Male:	44.	Pyloric stenosis.	+	Posterior with entero-anastomosis.	4 yrs.	Gastrocolic and jejunocolic fistulæ.	Separation, suture and ileo-sigmoidostomy.	Died.
28	Jahr-Krause, 1905.	Male;	29.	Pyloric stenosis.	—	Anterior with entero-anastomosis.	22 mos.	Ulcer adherent to parietes.	Separation; suture.	Recovered.
29	Eiselsberg, 1905.	?			?	?		?		?
30	Herczel, 1905.	?			?	?		Jejunocolic fistula.	Separation, closure of openings.	?
31	Gosset, 1905	Male;	42.	Stenosis with induration and great dilatation.	+	Posterior.	22 mos.	Ulcer of jejunum with jejunocolic fistula; wasting; diarrhœa, fæculent vomiting.	Separation of jejunum and colon; closure of the 2 openings and ileo-sigmoidostomy.	Recovered.
32	Battle.	Male;	30.	Pyloric stenosis.	Not known.	Anterior, with Murphy's button.	22 mos.	Perforation of jejunum close to anastomosis (1½ in. below).	Ulcer invaginated; abdomen washed out; drainage.	Recovered.
33	Battle.	Female; 37.		Pyloric stenosis, old perforation.	Not known.	Anterior.	13 mos.	Perforation of jejunum 1½ in. below anastomosis.	Ulcer sutured; lavage; no drainage.	Recovered.

The following case, in which there were two separate perforations of peptic ulcers in the jejunum, is recorded by Battle ("Lancet," vol. 1, 1905, p. 1246):—

The patient, a woman, aged 30, was admitted to St. Thomas's Hospital in March, 1903. The ulcer was situated in the anterior aspect of the stomach near the pylorus and was surrounded by a good deal of thickening. It was sutured, the peritoneum was cleansed, and a drainage tube was left in the lower wound. Anterior gastro-enterostomy was performed on April 9, 1904, for pyloric stenosis. On May 6, 1905, she underwent operation for perforation of a simple ulcer of the jejunum which had burst into the general peritoneal cavity. It was a circular clean-cut ulcer, situated about one and a half inches from the line of junction of the bowel with the stomach. The ulcer was sutured, the peritoneum was cleansed, and the two wounds through which this was done were closed without drainage. Finally, the patient was again admitted to the hospital on March 14, 1905, for symptoms of perforation. At the operation a perforated ulcer was found at the line of junction of the stomach and small intestine. The tissues around it were indurated. She left the hospital on April 12th, having made a very satisfactory recovery. It was of interest to note that there were no adhesions found at this operation; also that there was now no hernial protrusion of any of the scars.

7. The question of **chest complications,** parotitis, etc., is discussed elsewhere.

8. **Diarrhœa.**—An occasional sequel to the operation of gastro-enterostomy is the occurrence of diarrhœa. The attack may be slight, or may be so serious, so constant, uncontrollable and exhausting as to be the immediate cause of death.

It has been in my own experience extremely infrequent, and when noticed has been temporary and never alarming or serious. In only one case have special measures, dieting and the administration of opium, been necessary; the patient, a man of forty-six, was operated upon for duodenal ulceration, with recent excessive hæmorrhages. The diarrhœa lasted for five days, but,

although troublesome, was never so unremitting as to give me any real anxiety as to the patient's ultimate recovery.

Much more serious experiences are recorded by others. Kelling ("Archiv f. Klin. Chir.," Bd. 62, 1900) and Anschütz ("Mitth. a. d. Grenzgebiet," Bd. 15, 1905, p. 305) have dealt with the subject in detail.

Kelling remarks that in the cases which prove fatal no obvious explanation of the diarrhœa, is discoverable. He suggests that there are two forms: *First*, that in which the diarrhœa is due to the escape into the intestine of acid contents not neutralised by the bile and the pancreatic juice. *Second*, that in which it is due to "fermentation." The latter is not serious, and is seen only or chiefly in patients suffering from carcinoma, or in those cases where there is an absence of free HCl.

The explanation of the first form lacks adequate confirmation. In spite of the fact that both bile and pancreatic juice may almost constantly be found in the stomach after gastro-enterostomy, acid contents may still escape into the intestine, and may indeed cause peptic ulcer. But it has not been suggested, or recognised, that diarrhœa occurs especially in those suffering from hyperchlorhydria, as one would expect if this hypothesis were accurate.

With regard to the explanation of the second form, this may be true in certain cases. Fermentation may go on to such a degree in the stomach that no amount of careful lavage will ensure the cleanliness of the mucosa. This may be proved by examining a pyloric growth after pylorectomy has been performed; the recesses of the irregular mass are sometimes extremely foul. The delivery of putrid, fermenting food into the jejunum would, of course, instantly set up diarrhœa. It is always remarked that the stools in such a case are "very offensive." But in not a few cases the diarrhœa does not appear at once, but only after several days, when the patient has perhaps been doing well. It should also be remarked that cases have occurred after partial gastrectomy, when the infective area has been removed.

Anschütz believes the chief cause to be the excessive weakness of the patient, and remarks that the same type of diarrhœa is seen in those who suffer from advanced carcinoma elsewhere, or from extensive tuberculous disease apart from intestinal lesions. Carle and Fantino remark that the food runs through the intestine like water through a rubber tube, which is powerless to hasten or impede its progress.

It is apparent that no adequate explanation of this complication can be given; but it is probable that a strict attention to the diet, the administration of only sterile foods for some time after the operation, the giving of opium early, and the exhibition of drugs such as isoform, β-naphthol, salol, etc., whose purpose is to act as disinfectants, will comprise the most effective means at our disposal for preventing and for checking the onset of this symptom.

CHAPTER XIII.

OPERATIONS FOR CHRONIC GASTRIC ULCER. GASTRODUODENOSTOMY.

THE operation of gastroduodenostomy was first suggested by Jaboulay in 1892, and performed by him in 1894. In 1895 Kümmell independently suggested the same principle, the union of the duodenum to the stomach, but carried the principle out

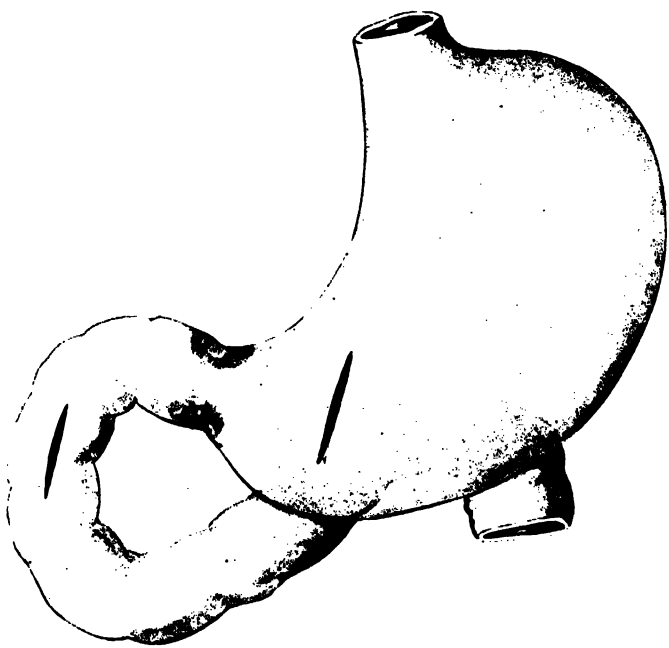


Fig. 65.—Gastroduodenostomy: lines of incision (Jaboulay's method).

by dividing the duodenum completely across, closing the proximal end, and transplanting the distal end into the anterior wall of the stomach near the greater curvature.

Jaboulay united the anterior wall of the duodenum to the anterior wall of the stomach, folding the duodenum forward over a hinge, as it were, formed by the pylorus. Villard de-

scribed a modification of the method under the term "subpyloric gastroduodenostomy." Instead of folding the duodenum over on to the stomach, he anastomosed the contiguous surfaces of the stomach and duodenum.

The operation is most easily performed when there is a largely dilated stomach and a mobile duodenum. In one case reported

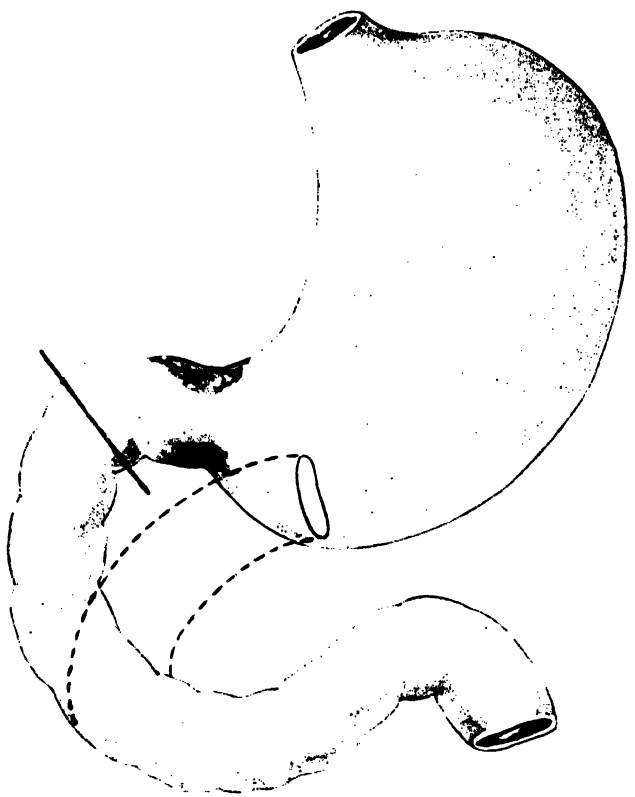


Fig. 66.—Gastroduodenostomy (Kümmell's method).

by Spencer any other gastro-intestinal anastomosis was impossible by reason of extensive adhesions which affected all of the pyloric portion of the stomach. When the pyloric region is adherent or invaded by growth, the operation is difficult or may be impossible.

The advantages of this procedure over gastrojejunostomy are claimed to be the easier emptying of the stomach at an ori-

fice near the natural outlet, and the absence of bile regurgitation, owing to the fact that the new opening in the intestine is placed above the bile papilla. The regurgitation of bile does, however, occur if a large opening be made.

The two methods of performing an anastomosis between the stomach and duodenum which enable the operation to be most satisfactorily completed are those described by Kocher

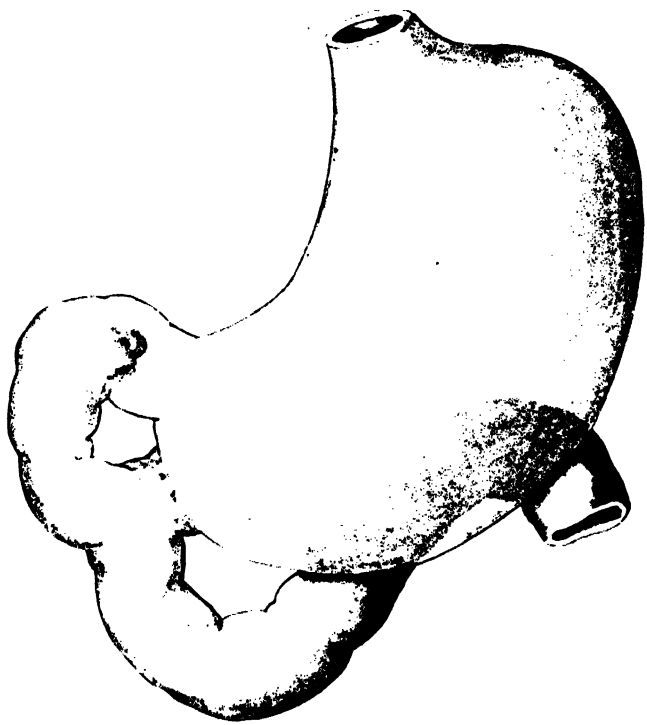


Fig. 67.—Gastroduodenostomy (Villard's method).

and Finney. Professor Kocher has recently suggested that the duodenum should be freed by stripping up the peritoneum to the right of the vertical (second) portion, so that an anastomosis between the stomach and the duodenum may be more readily performed. The following description is given by Professor Kocher ("Scott. Medical and Surgical Journal," October, 1903, p. 311):

"The most suitable incision is one similar to that which we recommend for exposing the gall-bladder, viz., an oblique incision two finger-breadths below and parallel to the right costal margin, beginning at the middle line. After dividing the skin and fascia, the rectus muscle is cut through as far as the broad abdominal muscles. The posterior layer of the rectal sheath, the fascia transversalis, and the peritoneum are divided. In muscular subjects the transversalis muscle is split parallel to its fibres, which are then firmly drawn apart. Should any adhesions exist between the gall-bladder and the colon, they must be divided. The liver is drawn upwards, the stomach to the left, and the transverse colon and the descending limb of the hepatic flexure downwards. The duodenum is then brought into view, and its outer border is clearly defined. A pad of gauze is placed against the under surface of the liver, and the latter is then drawn well upwards with a suitable retractor. Gauze compresses are also employed to push aside the stomach and colon.

"The delicate layer of parietal peritoneum covering the kidney is divided vertically 1½ inches external to the second part of the duodenum, and the incision is then continued vertically downwards through the upper layer of the transverse mesocolon (which is held on the stretch) as far as the larger branches of the vessels. The fingers are then introduced behind the left edge of the incision through the peritoneum, and the duodenum is separated from the vertebral column, the vena cava, and the aorta until it can be brought forward and pressed against the pyloric portion of the stomach, which, in its turn, is compressed against the left edge of the wound in the abdominal wall, so as to shut off the general cavity of the stomach and prevent escape of its contents. Both stomach and duodenum are now compressed above and below between the fingers of an assistant, and the lateral anastomosis is effected in the usual manner by two rows of sutures.

"To one who has once convinced himself how easily and securely this lateral gastroduodenostomy can be performed—provided the duodenum can be rendered sufficiently movable—it will be evident how admirably the operation fulfils the indications for treatment in stenosis of the pylorus. Unlike the other surgeons who have performed gastroduodenostomy, we

do not limit the operation to special cases: on the contrary, we regard it as the normal procedure, and we are of the opinion that it will take precedence over all the previous methods of gastro-enterostomy and pyloroplasty.

"The method is subject to only one contraindication, viz., the presence of such extensive adhesions to the under surface of the liver that the duodenum cannot be sufficiently freed. This difficulty of adhesions can, however, often be overcome, as we have proved in three of our cases; but the fact of having to perform the suturing inside the abdomen is apt to interfere with the security of the stitching, especially in difficult cases. It is on this account that subpyloric gastroduodenostomy did not meet with universal acceptance. The subpyloric portion of the duodenum cannot be drawn out of the wound on account of its connexion with the gastrohepatic omentum and the important structures contained within it. This fixation to the under surface of the liver may be so firm that only the lower two-thirds, or only the lower part, of the vertical portion of the duodenum, together with the inferior flexure, can be brought in contact with the stomach.

"We therefore propose that, instead of Villard's subpyloric gastroduodenostomy, the name lateral gastroduodenostomy be given to this operation, to distinguish it from our method of inserting the divided duodenum into the posterior wall of the stomach after resection of the pylorus. The great difference between Villard's subpyloric gastroduodenostomy and our procedure is that we render the descending portion of the duodenum, the inferior flexure, and a considerable portion of the third (transverse) part so movable that the parts to be sutured can readily be raised up and surrounded with gauze, so that the sutures can be introduced extraperitoneally with comfort and security.

"We intend in future to perform lateral gastroduodenostomy in all cases of stricture of the pylorus, and only to have recourse to gastrojejunostomy in cases rendered unusually difficult by firm adhesions. We have performed the operation on five occasions—four times for cicatricial stenosis and once for malignant stricture. The results have been convincing. Regurgitation of bile either does not occur at all or only at first, when a large, gaping opening has been made. It is advisable to make the anastomotic opening as high as possible, and not

too large. The patient with carcinoma was at once relieved of all her discomfort. Only one patient complained subsequently of very severe pain, and he had a simultaneous cholecystotomy performed for gall-stones. That a dilated and sacculated stomach is not so well emptied as by our inferior gastrojejunostomy is obvious. If gastroduodenostomy be performed in such a case, it is advisable to occasionally wash out the stomach."

Finney's operation was described by its originator as "a new method of pyloroplasty." I am indebted to Dr. Finney for the following description of his operation, and for the privilege of being allowed to witness its performance by him at the Johns Hopkins Hospital.

The operation is as follows:

"Divide the adhesions binding the pylorus to the neighbouring structures; also free as thoroughly as possible the pyloric end of the stomach and first portion of the duodenum. Upon the thoroughness with which the pylorus, lower end of the stomach, and upper end of the duodenum are free depends, in large measure, the success of the operation and the ease and rapidity of its performance. I wish to emphasise this as one of the most important points in the operation. Frequently, at first sight, the pylorus may seem hopelessly bound down, when, after a little patient toil and judicious use of the scalpel and blunt dissector, it is found that it can be freed with comparative ease. A suture, to be used as a retractor, is taken in the upper wall of the pylorus, which is then retracted upwards. A second suture is then inserted into the anterior wall of the stomach, and a third into the anterior wall of the duodenum, at equidistant points—say about 12 cm.—from the suture just described in the pylorus. These second sutures mark the lower ends of the gastric and duodenal incisions respectively. They should be placed as low as possible in order that the new pylorus may be amply large. Traction is then made upwards on the pyloric suture, and downwards in the same plane, on the gastric and duodenal sutures. This keeps the stomach and duodenal walls taut, and allows the placing of the sutures with greater facility than if the walls remained lax. The peritoneal surfaces of the duodenum and stomach, along its greater curvature, are



Fig. 68.—Finney's operation. The duodenum and stomach are clamped. The line of incision is shewn.



Fig. 69.—Finney's operation. The first line of suture complete, the stomach and duodenum opened, and the inner suture commenced.



Fig. 70.—Finney's operation. The inner suture nearly completed.



Fig. 71.—Finney's operation. The outer suture completed.

then sutured together, as far posteriorly as possible. For this row I would recommend the use of the continuous suture, as it is more easily and quickly applied, and it can be reinforced after the stomach and duodenum have been incised. After the posterior line of sutures has been placed, an anterior row of mattress sutures is taken, which are not tied, but left long, in the

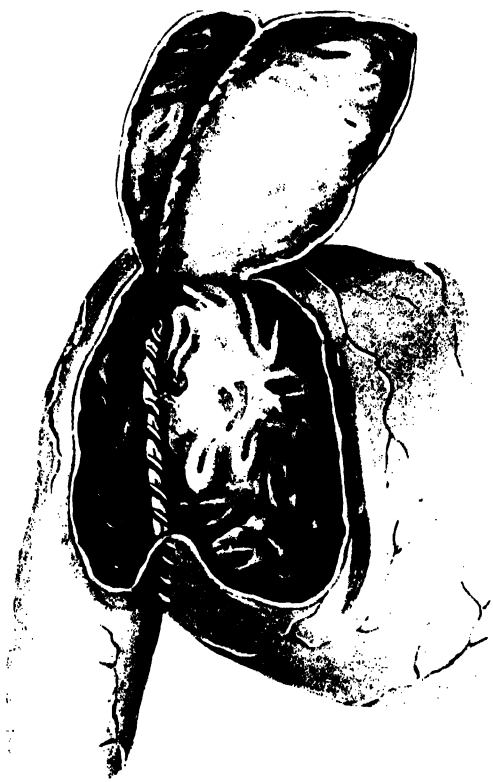


Fig. 72.—Finney's operation. A flap turned upwards to shew the alteration in the parts produced by the anastomosis (after Sinclair White).

manner indicated. These sutures, after they have been placed, are retracted vertically in either direction from the middle of the portion included in the row of sutures. Then, after all the stitches have been placed and retracted, the incision is made in the shape of a horseshoe. The sutures should be placed far enough apart to give ample room for the incision. The gastric arm of the incision is made through the stomach-wall just in-

side the lowest point of the line of sutures, and is carried up to and through the pylorus and around into the duodenum, down to the corresponding point on the duodenal side. Hæmorrhage is then stopped. It is well to excise as much as possible of the scar tissue upon either side of the incision in order to limit, as far as possible, the subsequent contraction of the cicatrix. This procedure I carried out in two of my cases with great satisfaction, and I should strongly recommend it in all cases where the walls of the pylorus are much thickened and there is much scar tissue present. It is well, too, to trim off with scissors redundant edges of mucous membrane, in order to prevent the formation of a valve-like fold of mucous membrane at the new pylorus. A continuous catgut suture is now taken through and through all the coats of the intestine on the posterior side of the incision. This reinforces the posterior line of sutures, secures better approximation of the cut edges of the mucous membrane, and prevents the reunion of the divided intestinal walls. The anterior sutures are then straightened out and tied, and the operation is complete, unless one wishes to reinforce the mattress sutures with a few Lembert stitches. This procedure, as is readily seen, gives the minimum of exposure of infected surface. All the stitches are placed and the posterior row tied before the bowel is opened, and it remains open just long enough to control the hæmorrhage. The size of the newly formed pyloric opening is limited in this operation only by the mobility of the stomach and duodenum and the judgment of the operator.

"In all of my cases the incision has been about 12 cm. in length, and could have been made longer had I chosen to make it so. Unless the stomach is very much dilated or has descended to an unusual extent, the lower limit of the new outlet is at or near the level of its most dependent portion."

I have, when performing Finney's operation, modified this method of performing it. I have, in fact, applied to the operation of gastroduodenostomy the method adopted in the operation of gastro-enterostomy; that is to say, I have applied clamps to the stomach and to the duodenum, and from both these viscera a large ellipse of the mucous membrane has been excised after division of the serous and subserous coats. The

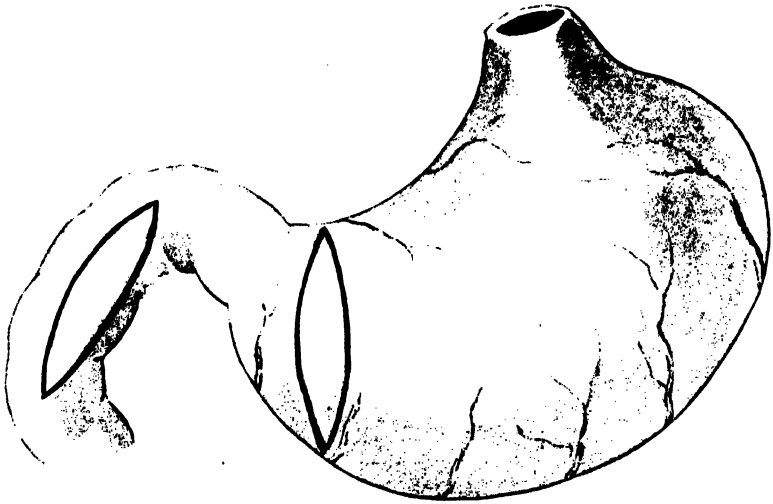


Fig. 73.—Gastroduodenostomy; shewing the parts to be embraced by the clamp.

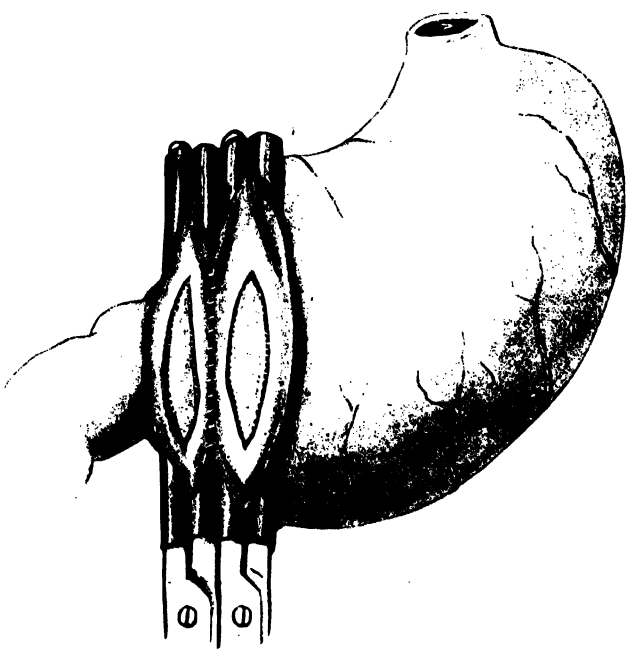


Fig. 74.—Gastroduodenostomy; the parts embraced by the clamps and the position of the anastomotic opening.

clamps prevent hæmorrhage and the escape of fluids from the stomach and duodenum, and thereby make the operation speedier and simpler.

For this operation I have had made a special form of clamp, the blades of which at their origin are sharply bent at a right angle. The duodenum, even after being "mobilised," cannot always be brought easily to the surface; but with this clamp the bowel can be well secured, because the blade lies well within the abdomen, when the handle lies flat upon the surface.

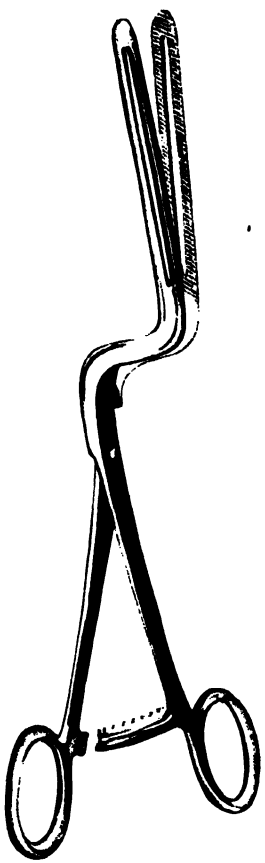


Fig. 75.—Moynihan's clamp for use in Finney's operation.

The operation of pyloroplasty has already fallen, or is certainly doomed to fall, into complete disuse. Even in the hands of its warmest advocates it was an unsatisfactory operation, and the number of cases in which there was a recurrence of symptoms was very large.

The operation of Finney and the operation of Kocher have, however, a distinct place in surgery, and it is by no means unlikely that in the future they will be performed in a certain class of cases for which gastro-enterostomy is now the chosen method. It has seemed to me that in those cases where pyloric spasm is a prominent condition, where it is caused by ulceration in active progress at a point a little distant from the pylorus, Finney's operation will be especially of service. In the ordinary case of pyloric stenosis, with dilatation and hypertrophy of the stomach, no operation could be more satisfactory than posterior gastro-enterostomy; for these cases it is hardly possible that it can ever

be replaced by an operation which is easier, speedier, or safer. In cases of active ulceration and pyloric spasm it is probable that Finney's operation will prove to be of great value.

In certain cases of hour-glass stomach a modification of Finney's operation may be used, as suggested by Kammerer.

CHAPTER XIV.

OPERATIONS FOR HOUR-GLASS STOMACH.

An hour-glass stomach may be congenital or acquired. Congenital hour-glass stomach, the existence of which I have formerly disputed, is extremely rare. Only one undoubted case has been reported. Acquired hour-glass stomach may be due to the contraction of a chronic ulcer situated in the body of the organ, to cancer, to localised perforation of an ulcer in the body of the stomach followed by adhesion and anchoring of the stomach to the anterior abdominal wall or to the pancreas, and, finally, to perigastric adhesions which compress the stomach at or near its centre. In one remarkable case upon which I operated two constrictions were present, so that a triloculated stomach was formed.

The stricture which divides the stomach into two portions may be placed at any point between the cardiac and pyloric orifices. As a rule, it is nearer to the pylorus than to the cardia, and as a result of the obstruction which it causes the cardiac pouch undergoes a marked dilatation. In the great majority of cases the greater curvature is pulled upwards to the lesser, but in two cases I have seen the normal outline of the greater curvature has been unaltered, the lesser curvature being tucked down towards it.

Hour-glass stomach is very much more common than was formerly believed. I have operated upon 19 well-marked examples. The condition, I believe, is occasionally overlooked, owing to an imperfect examination of the stomach. When, as not seldom happens, there is an obstruction at the pylorus as well as in the body of the stomach, the food, after passing from the cardiac into the pyloric pouch, again meets with an obstruction, and finds great difficulty in escaping through the narrowed

pylorus into the duodenum. The pyloric pouch then becomes gradually dilated and hypertrophied. It may, indeed, be so large that when the abdomen is opened it is mistaken for the whole stomach and a gastro-enterostomy is performed between it and the jejunum. Such an operation is, of course, doomed

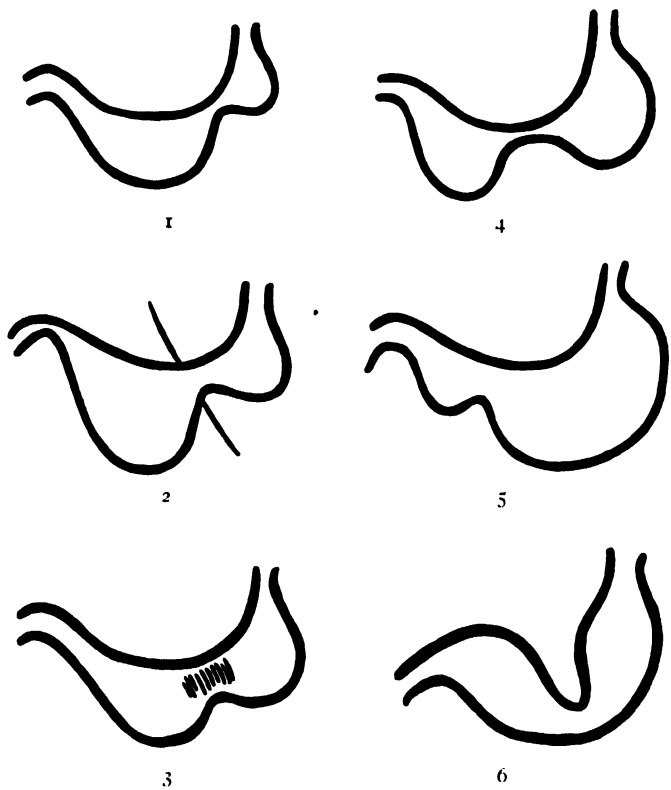


Fig. 76.—Types of hour-glass stomach: 1, Obstruction near cardiac end; 2, cardiac pouch concealed by adhesions; 3, growth in body of stomach; 4, two pouches connected by a narrow tube; 5, cardiac pouch largely dilated; 6, lesser curvature pulled down towards the greater.

to complete failure; for the symptoms are mainly due to the stenosis between the cardiac and the pyloric pouch, which is unrelieved. The most necessary precept to bear in mind in operating upon the stomach is that the *whole stomach*, from cardia to pylorus, should be seen and felt before any anastomosis is made. In at least three recorded cases a lack of ade-

quate and precise knowledge of the condition of the stomach has led to futile measures and fatal results.

In many cases of hour-glass stomach, as I have said, there is, in addition to the constriction in the middle of the organ, a narrowing due to old ulceration at the pylorus. It is because of this dual stenosis that the treatment by operation is often a matter of difficulty. In such circumstances no single operation will suffice to cure the patient; for if gastro-enterostomy is performed between the cardiac complement and the jejunum, food will escape through the isthmus into the pyloric pouch, and, there stagnating, will undergo decomposition and cause distension, flatulence, pain, and the occasional vomiting of putrid fluids. If the anastomosis is made between the pyloric pouch and the jejunum, the symptoms which the operation was destined to relieve will persist. In these cases, therefore, a double operation must be performed; a free passage must be made from the cardiac pouch to the pyloric, and thence to the jejunum. The following operations may be performed:

1. Gastro-enterostomy, single or double.
2. Gastroplasty.
3. Gastrogastrostomy or gastro-anastomosis.
4. Partial gastrectomy.
5. Dilatation of the constriction.

1. **Gastro-enterostomy** alone is suitable for a certain number of cases. When the constriction is within two or three inches of the pylorus, the pyloric pouch is small, not dilated, and, from the surgical point of view, is negligible. Nothing more is necessary to effect a cure than a free outlet from the cardiac pouch, and this is afforded by a gastro-enterostomy. The cardiac pouch is dealt with as though it were the whole stomach.

If both pouches require to be drained, a double gastro-enterostomy may be performed, as suggested by Weir and Foote. A long loop of the jejunum close to the flexure is isolated and is united to the two pouches by two separate anastomoses. Each pouch, therefore, drains into this loop. I

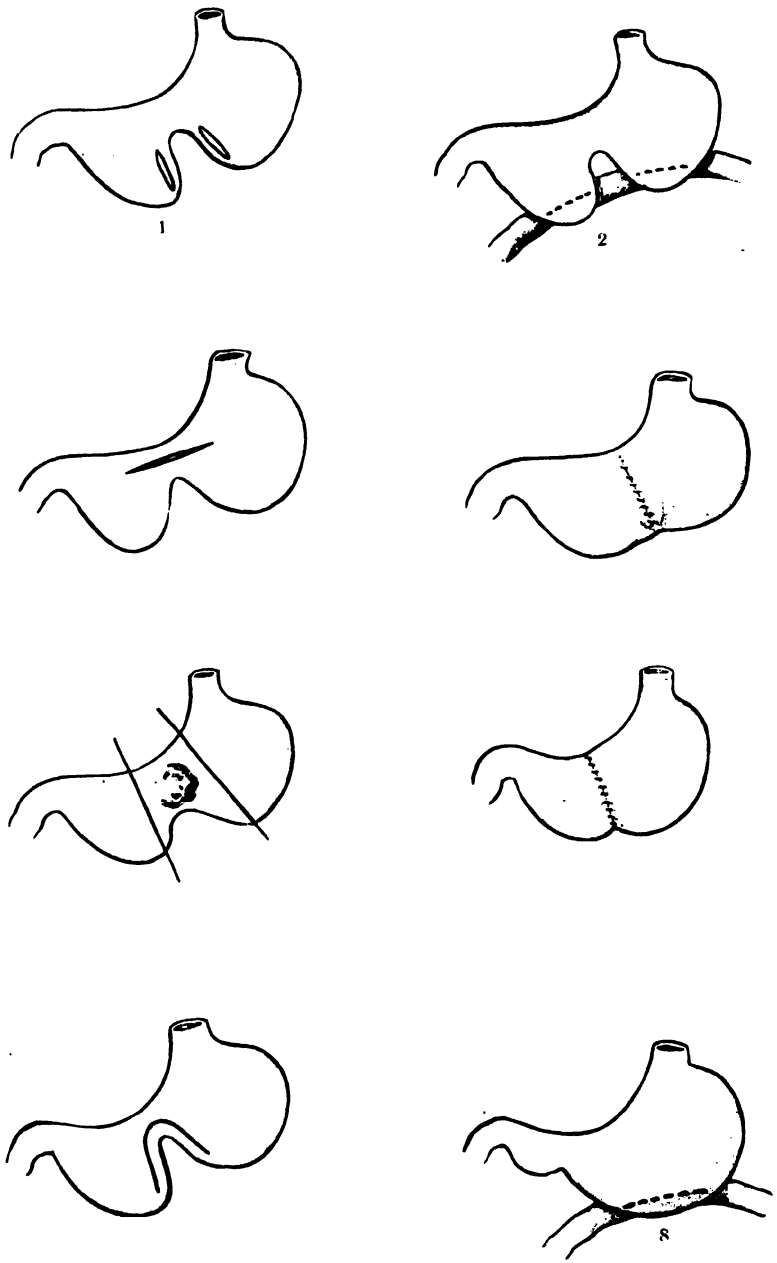


Fig. 77.—The operations for hour-glass stomach: 1, Gastrogastrostomy; 2, double gastro-enterostomy (Weir); 3, gastroplasty (the line of incision); 4, gastroplasty (the line of suture); 5 and 6, partial gastrectomy; 7, Kammerer's operation; 8, gastro-enterostomy.

have never given this operation a trial, but it is one which would probably prove successful.

2. **Gastroplasty** is an operation the rôle of which is very limited. It is applicable only to those cases in which a narrow stricture is present in the absence of induration, active ulceration, or external adhesion. In many of the recorded cases it is noted that there was "recovery without relief." It is probable that, as with pyloroplasty, the operation will be abandoned in favour of worthier methods. The cases to which it is suited are few, and more successful operations can be practised even in them. The operation consists in making a long transverse incision or slightly curved incision through the stricture, and continuing the incision well onwards into the healthy stomach-wall of both pouches. The incision should be at least 4 inches in length. The transverse incision is now made into a vertical one by applying a pair of clips at the middle of the upper and lower edges, and drawing them as far apart as possible. The wound is then sutured. It is the operation of pyloroplasty applied to the body of the stomach.

Dr. Kammerer, of New York, has adopted a modification of gastroplasty that will relieve the operation of many of its objections. His method bears the same relation to gastroplasty as Finney's operation does to pyloroplasty. His description is as follows: "Beginning at the lowest point of the constriction, a running suture was applied through the serous and muscular coats, bringing the vertical edges of both compartments of the stomach into close approximation along their posterior margins. An inverted V-shaped incision was now made through the suture thickness of the stomach-wall, about ¼ inch to either side of the Lembert suture. The posterior wound edges were now brought together with another running suture from within, the same procedure being then applied to the anterior edges from without. The final act of the operation consisted in reenforcing the anterior suture with a running Lembert stitch, and placing a few extra sutures at the lowest point of the stomach

through the serous and muscular coats, where tension would naturally be greatest." The patient made an excellent recovery.

3. **Gastrogastrostomy or Gastro-anastomosis.**—This operation was first performed by Wölfler in 1894. He made vertical incisions 7 cm. in length into the dependent pouches on each side of the central constriction, and united these so as to form a free passage beneath the isthmus.

The stomach is clamped on each side of the isthmus, and the clamps are surrounded with hot, moist sterile gauze. A suture

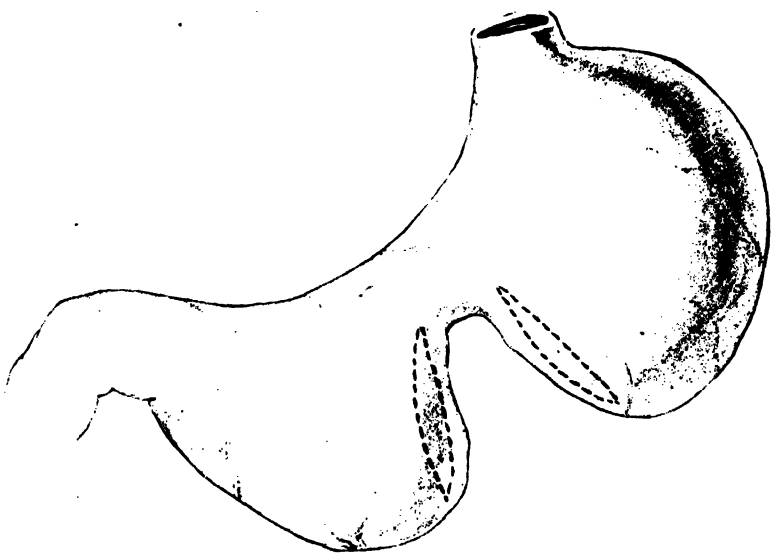


Fig. 78.—Hour-glass stomach. The dotted lines indicate the position of the openings in the operation of gastrogastrostomy.

is then passed through the serous and muscular coats of the part of the stomach, on each side, below the isthmus, reaching from it to the greater curvature. The needle is then temporarily laid aside. The incisions are then made in front of the suture line, through all the coats to the mucosa, a large ellipse of which is excised. A continuous suture, picking up all the coats, is then passed along the cut margins posterior and then anterior until the opening is completely encircled. The original needle which had been laid aside is again picked up, and an anterior

line of sutures is completed. The operation, in fact, is precisely the same as the operation of gastro-enterostomy, save that the stomach is embraced by both clamps instead of by one only.

Sedgwick Watson in 1895 successfully performed gastro-gastrostomy in a different manner. The incisions in the two segments of the stomach were transverse. The pyloric portion of the viscus was folded over the cardiac, with the isthmus

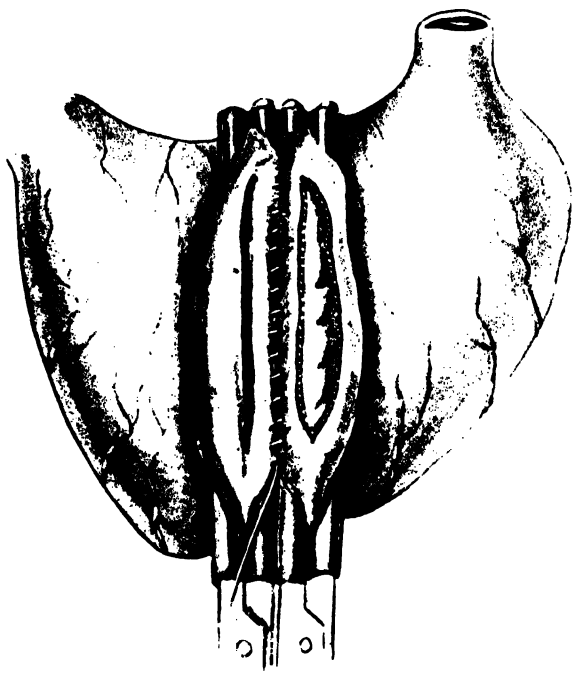


Fig. 79.—Hour-glass stomach. The application of clamps and the method of suture in gastrogastrostomy. The details are the same as in the operation of gastro-enterostomy.

as a hinge, and the two stitched together with an elliptical line of sutures before being opened. The anastomosis was then made by incising the wall of the compartment which now lay anterior, and through the opposite side making an opening into the cardiac pouch in the centre of the elliptical area which had been surrounded by the suture. This method has never been repeated, so far as I know.

4. **Partial gastrectomy** will more often be practised in cases of cancer than in cases of simple disease. In cancer a wide excision is necessary, upon the lines laid down in the chapter dealing with operations for malignant disease of the stomach. When the mass of growth has been removed, an end-to-end approximation of the stomach can be made, or both cut ends may be closed and an anastomosis made between the cardiac pouch and the jejunum.

5. **Digital Divulsion or Dilatation.**—Operations of all kinds upon hour-glass stomachs may be made difficult by the adhesion of the ulcer whose contraction is responsible for the deformity. Adhesion to the anterior abdominal wall, to the liver, or posteriorly to the pancreas may be so strong that the operative manipulations are greatly embarrassed. A separation of the stomach from the anterior abdominal wall is always possible, though, as in cases of my own, a portion of the abdominal wall has to be removed, or the stomach laid open in so doing.

When the stomach is adherent posteriorly, or when, owing to the infinite complexity of adhesions, the cardiac pouch cannot be reached, the constriction between the two pouches may be dilated by the fingers until a free communication exists below the cardiac and pyloric segments. In one case I was unable to do more than this. The mass in the stomach I took to be, with the experience I then possessed, malignant and irremovable. The cardiac pouch, owing to adhesions, was beyond the possibility of inspection or manipulation, and I was, therefore, compelled to be content with a retrograde dilatation of a very narrow constriction. To my surprise the patient made a perfectly uneventful recovery; she rapidly gained over three stones in weight, and to this day remains well, all trace of a tumour having disappeared.

A full account of the subject of hour-glass stomach with a record of my cases will be found in the "British Medical Journal," February 20, 1904, p. 413.

SUMMARY AND ANALYSIS OF THE CASES OF NON-MALIGNANT DISEASE OF THE STOMACH TREATED BY THE AUTHOR.

The following is a summary and a brief analysis of all the cases of *non-malignant diseases* of the stomach upon which I had operated up to the end of the year of 1905.

The cases are arranged in four groups:

Class 1. Acute perforating ulcer of the stomach and duodenum.
Class 2. Cases in which hæmorrhage was the cause of immediate operation.
Class 3. Chronic ulcer. Dilated stomach, etc.
Class 4. Hour-glass stomach.

Class 1.

Summary of Cases of Acute Perforating Ulcer.

Since April 30, 1897, the date of my first operation, I have had under my care 24 cases of perforating ulcer of the stomach or duodenum. In these 24 cases there were 15 recoveries (62.5 per cent.) and 9 deaths (37.5 per cent.). There were 8 cases in which a duodenal ulcer had perforated, and 16 in which a gastric ulcer had perforated. In the first 10 cases there were 6 deaths; in the last 14 cases there were 3 deaths. My first case recovered, and then, in succession, were five unsuccessful cases.

The ages of the patients varied from seventeen to forty-four. The cases of gastric ulcer were 16 in number. Of these two were males, aged twenty-three and twenty-four, and 14 females of average twenty-seven and one-twelfth years. The cases of duodenal ulcer were 8 in number. Of these 4 were males, aged forty-four, twenty-five, twenty-two and forty, and 4 females, aged seventeen, seventeen, twenty-five, and thirty-eight.

An enquiry into the previous history of the cases of gastric ulcer showed that in every case, with one exception, and in that no record of enquiry is made, the patient had suffered from symptoms referable to the ulcer for periods varying from a few weeks to several years. Of the 12 patients, 6 had been under treatment within a year of the occurrence of the perforation for indigestion, vomiting, or hæmatemesis and anæmia.

Similarly, in every case of perforated duodenal ulcer, previous symptoms had been observed, and 4 of the 8 patients had been recently under treatment. In none of these cases had relief been afforded.

In the majority of the patients there had been no increase in the severity of the symptoms during the few days preceding perforation. In 3 of the 24 cases, however, a distinct and notable exacerbation is recorded.

The time which elapsed between the perforation of the ulcer and operation varied from three hours and fifty minutes to four days.

The perforation was found on the anterior surface of the stomach in 14 cases; on the posterior surface in 2 cases. As a rule, the perforation was near the lesser curvature and towards the cardiac end. In 1 case, two perforations were found, both on the anterior surface, about 1½ inches apart. In 1 case the perforation occurred in the centre of an hour-glass stomach, and gastroplasty had to be performed. In the 8 duodenal cases the perforation was found in the first portion seven times; in the beginning of the second portion, once. In 4 cases in the whole series, gastro-enterostomy was performed immediately after the closure of the perforation; in 3 cases recovery followed. In 2 cases the subsequent performance of gastro-enterostomy has been necessary owing to the persistence of symptoms due to the ulcer, or to the scar left by it. There were, therefore, 15 cases of recovery from the perforation; in 3 of these gastro-enterostomy had been performed, and in one gastroplasty for an hour-glass stomach. Of the remaining 12, 2 suffered to such a degree as to necessitate the performance of a second operation —gastro-enterostomy.

In the 24 cases there were, therefore, 7 in which an immediate or a subsequent operation for the adjustment of the mechanical conditions of the stomach was necessary. Two of the patients suffered from perforation while they were waiting for operation,—one in the hospital, one in a nursing home. Both had complained for years of indigestion and vomiting; both had dilated and hypertrophied stomachs for which a gastro-enterostomy was to be performed. In one, a duodenal ulcer, in the other an ulcer at the pylorus, had perforated. In both, the ulcer was closed and an immediate gastro-enterostomy was

performed. Both patients recovered and remain perfectly well. In 1 case the patient was operated upon for the perforation of a gastric ulcer and was apparently doing well. On the thirteenth day she was suddenly seized with acute pain, became collapsed and died in an hour and a half. At the postmortem, a perforation of a duodenal ulcer was found.

The cause of death in 7 cases was shock, or a want of recovery from the condition of collapse, often profound, which existed before operation. In 1 case, death resulted from empyema, and in 1 case from subphrenic abscess and suppuration at several points within the abdomen.

None of the patients who recovered suffered from any chest affection,—from parotitis, thrombosis of veins, or from hæmatemesis during the time they were under treatment after the operation. In one of the fatal cases there was slight hæmatemesis. The question of drainage was determined entirely by the needs of each individual case. There was no rule in one's mind that had necessarily to be followed; what seemed appropriate to the case was adopted. As a rule, the earlier the case was seen the less was the need for drainage. Lavage was adopted only when the case was of long duration. When the stomach was found distended with fluids it was emptied by the stomach-tube during the operation. In all, drainage of the abdomen was adopted in 12 cases; in 2 of these posterior drainage, as well as anterior, was necessary, and in 2 others suprapubic drainage, as well as drainage through the wound, was established.

Class 2.

Summary of Cases in which Acute Haemorrhage was the Immediate Cause of Operation.

In 27 cases the hæmorrhage was sufficiently severe to demand operation for its relief alone. In 2 of these no ulcer was found at operation; in 14, gastric ulcers alone were found, 4 cases having multiple ulcers. The ulcers were situated near the pylorus in 10 cases, and on the lesser curvature in 3.

In 7 cases, duodenal ulcers alone were found, involving the first part in all but 1.

In 4 cases, duodenal and gastric ulcers were observed.

Hæmatemesis only (without melœna) occurred in 8 cases,

6 having gastric ulcer, 1 gastric and duodenal ulcers; in 1 no ulcer was found.

Melœna alone occurred in 4 cases, all of which had duodenal ulcers only.

Hæmatemesis and melœna together were noted in 15 cases, 8 having gastric ulcer, 3 duodenal ulcer, 3 gastric and duodenal ulcers; there was 1 in which no ulcer could be found.

	Hæmatemesis.	Melœna.	Both.
Gastric ulcer	6	–	8
Duodenal	–	4	3
Gastric and Duodenal	1	–	3

Mortality.—Four of these cases died—one in four hours from the operation, at which no ulcer could be found. At the autopsy dilated gastric veins and cirrhosis of liver were demonstrated; 1 on the eleventh day from pneumonia; 1 on the eighteenth day from exhaustion; and 1 in three weeks from gradual exhaustion (in this case the blood contained only 47 per cent. hæmoglobin before operation). In no case did hæmorrhage recur after operation. In 3 of the cases which recovered, the estimation of hæmoglobin before operation was only 18 per cent.

Operative Treatment.—In every case but 1 posterior gastrojejunostomy was performed. In 20 this was the only treatment adopted; 2 of these died.

Gastrojejunostomy was combined with excision of the ulcer in 2 cases, 1 of which died.

Gastrojejunostomy, with infolding of the ulcer, was done twice.

Gastrojejunostomy, with infolding of a pyloric ulcer, in 1 case, which died.

Gastrojejunostomy, with infolding of the pylorus and of the ulcer, was performed once; the patient recovered.

Excision of the ulcer was performed once; the patient died on the eighth day.

Class 3.

Chronic Ulcer, Etc.

The following is an analysis of all cases of simple disease of the stomach (except those operated upon urgently for perfora-

tion and those operated upon for hour-glass stomach) upon which I have operated:

In this series there are 236 operations upon 230 patients.

In the 230 patients, evidence of an ulcer was found in 213.

Gastric ulcer alone was found in	150	cases.
Duodenal ulcer alone was found in	33	"
Both gastric and duodenal ulcer in	30	"

Of the remaining 17 cases, 5 suffered from pyloric obstruction due to chronic cholecystitis; no ulcer could be found in 11 (in 1 of these the symptoms were due to gastroptosis), and in 1 the condition found is not recorded.

As regards the symptoms in 230 cases, vomiting is noted as having occurred in the course of the patient's illness in 183 cases. Hæmatemesis had been noticed in 79 patients (including the case of cirrhosis and uræmia). In 21 of these the hæmatemesis was associated with melœna, while melœna only was noticed in 10 cases. Peristaltic waves were visible before operation in 52 cases. A palpable tumour was recognised before operation in 7 cases. It was due to inflammatory lump at the pylorus in 4 cases; to inflammatory lump at the pylorus and duodenum in 1 case; to inflammatory lump in the duodenum and chronic pancreatitis in 1 case, and to universal gastric adhesions in 1 case.

Tetany of varying degree was noted in 10 cases; in all there was gastrectasis.

Coldness, lividity, and cyanosis occurred in 15 cases, and I feel sure in several others where I omitted to make a note of them.

As regards the relation between pain and gastric adhesions: In the histories of 189 patients, pain is definitely noted; in 100 of these, gastric or duodenal adhesions were found at operation. The pain is described as "severe" in 32 cases, 19 of which had adhesions. The occurrence of a former perforation is suggested, either by the previous history or by the conditions found at operation in 10 cases of this series. In 2 the perforation was "acute;" in 8 probably "subacute."

Gastric ulcer alone, 70.4 per cent.

Of the 150 cases where gastric ulcers alone were found, 101 (67.3 per cent.) were in females and 49 (32.7 per cent.) in males.

In 105 cases but a single ulcer could be found; in 67 of these it was at or near the pylorus; in 7 on the anterior wall; in 14 on the posterior wall; in 5 near the cardia; while the majority of the remainder were on the lesser curvature.

In 45 cases the ulcers were multiple, the greater number of these being at or near the pylorus, and on the posterior surface. In addition to these, 18 cases of single ulcer shewed adhesions elsewhere. These adhesions undoubtedly marked the site of former ulcers, so that the proportion of single to multiple ulcers in the stomach only was 87 to 63.

The incidence of pain after food in 51 cases was:

Within one hour	51 per cent.
One to two hours	27.5 "
Two to three hours	13.7 "
"Hunger pain"	7.8 "

Duodenal ulcers alone, 15.5 per cent.

Of the 33 cases where duodenal ulcer alone was found, 24 (72.7 per cent.) were in males and 9 (27.3 per cent.) in females. In the 27 cases where the position of the ulcer was noted, it was situated: In the first part in 23 (85.2 per cent.); in the second part in 2 (7.4 per cent.); while in 2 cases two ulcers were found, one in the first and one in the second part.

The incidence of pain after food in 21 cases was:

Within one hour	14.3 per cent.
One to two hours	33.3 "
Two to three hours	23.8 "
"Hunger pain"	23.8 "
At night	4.8 "

Duodenal and gastric ulcer, 14.1 per cent.

Duodenal combined with gastric ulcers were found at operation in 30 cases, 18 (60 per cent.) being males, and 12 (40 per cent.) being females.

In 21 cases only one ulcer was found in the stomach, generally situated near the pylorus; in 7 cases, more than one gastric ulcer was found.

The situation of the duodenal ulcer was noted in 22 cases; the first part of the duodenum was involved in 19 cases.

The incidence of pain after food in 15 cases was:

Within one hour	40	per cent.
One to two hours	13.3	"
Two to three hours	13.3	"
"Hunger pain"	26.7	"
At night	6.7	"

Comparison of Gastric with Duodenal Ulcer.

	Male.	Female.
Gastric	32.7 per cent.	67.3 per cent.
Duodenal	66.7 "	33.3 "

Hæmorrhage.—The relation between duodenal ulcer and hæmorrhage is brought out in the following table:

	Hæmat.	Melæna.	Both.	No Hæmor.
Of all cases of peptic ulcer (213)	56	10	21	126
Of all cases of duodenal ulcer	7	8	12	36

Operative Treatment.

Gastro-enterostomy	Gastro-jejunostomy	Posterior	Suture	216	Total 224
			Murphy's button	1	
		Anterior	Laplace forceps	3	
			Simple	1	
			Roux	1	
	Gastroduodenostomy (Finney)			2	
Pyloroplasty				3	
Enteroplasty				1	
Gastro-enteroplasty				1	
Entero-anastomosis	anastomosis in Y (Roux)			1	
	lateral anastomosis			4	
Excision of ulcer alone				1	
Exploratory				1	
			Total	236	

Three of the earliest gastrojejunostomies were done with the aid of Laplace forceps; 2 of these were quite satisfactory, but the third relapsed after one month of relief, and a second gastrojejunostomy with Murphy's button was done. The former opening was found almost completely closed.

Gastro-enteroplasty.—In 2 cases gastro-enterostomy had previously been performed by other surgeons, and after temporary relief the symptoms had returned. In 1 case the anastomosis had been made by Murphy's button, and I found the opening almost closed. In the other case the anastomosis, made by the aid of a bone bobbin, had contracted, and was found high up on the posterior surface, near the lesser curvature. In the

former case the opening was considerably enlarged, and the union of the stomach and the jejunum effected by suture; in the latter the opening was brought down to the greater curvature by a plastic operation, and, owing to the existence of a long jejunal loop, a Roux operation also was performed, the loop being divided, the distal end closed, and the proximal implanted into the side of the jejunum about three inches below the anastomosis.

Entero-anastomosis was necessary in 4 cases, owing to the constant vomiting of bile after the operation. Two of these cases occurred early in my experience, before I adopted the "short-loop" operation. The result in both was most satisfactory. In the third case, anterior gastro-enterostomy had been performed by another surgeon. Persistent vomiting followed. I reopened the abdomen and found the distal limb of the jejunum constricted by numerous adhesions. These were divided, and entero-anastomosis also performed. The result was good. In the fourth case a hernia of the small intestine through the opening in the mesocolon was found. Benefit was derived from reduction of the hernia, closure of the opening round the anastomosis, and entero-anastomosis.

Roux's operation was performed twice, once in the case mentioned above, and once in a patient upon whom I had previously operated for a perforating ulcer. Owing to the extremely dense and very numerous adhesions I could not obtain access to the posterior surface of the stomach, and I therefore performed Roux's operation, to the anterior surface.

Enteroplasty was performed in one case. Gastro-enterostomy had been performed two years before by another surgeon, but after some months of relief vomiting returned and became serious at the last. On reopening the abdomen I found the distal limb of the jejunum constricted by a very tight band, the division of which did not relieve the place of constriction in the bowel where a stricture had developed.

Two of the 3 cases of pyloroplasty required a subsequent gastrojejunostomy, which effected a cure; one case relapsed in five weeks, the other in three years and six months after the pyloroplasty.

Other secondary operations in this series are:

One gastrojejunostomy by suture for return of symptoms two years after posterior gastrojejunostomy by Murphy's button;

the former opening was found to be almost closed. One gastro-jejunostomy for return of symptoms after gastroplasty for hour-glass stomach.

In 6 cases cholecystotomy, and in 1 case cholecystectomy, were performed at the same time as gastrojejunostomy. In 1 case ovariotomy was simultaneously performed, and in 1 case radical cure of a right inguinal hernia. In 1 case, gastric ulceration following the drinking of corrosive acid, the gastrojejunostomy was supplemented by Senn's gastrostomy, and a catheter inserted through the latter opening was directed into the efferent jejunal limb, through which the patient was fed for two and a half weeks. In 1 case, Beyea's operation, and in 1 case Coffey's operation for gastroptosis with peripyloritis was performed. Both patients are completely relieved.

In 1 case perforation of a pyloric ulcer occurred three hours before the time arranged for operation. In a second case, a perforation of a duodenal ulcer occurred about two hours before operation. At both operations the perforation was closed and gastro-enterostomy performed.

Hæmatemesis occurred shortly after gastrojejunostomy in 2 cases, but in neither was it lasting.

Obstruction due to hernia of the small gut through the opening in the mesocolon occurred thrice; in 2 cases the hernia was reduced, once by myself, once by another surgeon; the third patient died.

Stitch abscesses were noted three times, followed in 1 case by slight bulging at the site of the wound.

Parotitis delayed recovery in 2 cases, one gastrojejunostomy and one gastroduodenostomy.

Mortality.—In the 209 operations for chronic ulcer, apart from acute hæmorrhage, there were two deaths. In this series there have been 111 cases in succession without a death.

In this complete series all the cases upon which gastro-enterostomy was performed were *cured* with the exception of 15; of these 10 may be classed as "relieved," and 5 as "no better."

"NO BETTER."

1. A case of contracted stomach with extensive perigastritis. The condition was possibly syphilitic. The last report is that "operation has not made much difference."

2. A case of a girl in whom adhesions of the pyloric end of the stomach to the anterior abdominal wall were found. Pain and vomiting were continuous before the operation; ceased after operation, while the patient was in the infirmary, but have returned as severely as ever. Dr. Stitt Thomson writes, "She is altogether in a very unsatisfactory condition." This, I think, is the most unsatisfactory case of all. (This patient has since improved considerably after the performance of Roux's operation.)

3 and 4. There are two patients whose symptoms were due to no ulcer discoverable at the operation. They are intensely neurotic and I believe that that is the explanation (if it can be called one) of their condition. They are both in virtually the same condition as before the operation.

5. A case of ulcer adherent to the under surface of the liver. There was great improvement and a gain of two stones in weight, but lately pain and emaciation have been observed.

"RELIEVED."

In 3 cases the ulcer was on the lesser curvature close to the cardia with adhesions to the under surface of the left lobe of liver and diaphragm. These patients are all better since the operation; two of them have gained over one and one-half stones, but all of them complain still of occasional pains, sometimes severe, radiating upwards into the chest. In one of these pyloric obstruction also was present, due to a second ulcer. In one, the patient who gained over three stones after the operation has lost almost two stones of this increase, and has to restrict her food almost entirely to semisolids and fluids.

In 6 cases hyperchlorhydria was marked before the operation, and in these the lack of complete recovery may be due to a persistence of this condition. They all complain of "burning" pain in the epigastrium, fullness after meals, and flatulent distension of the epigastrium. All are relieved by a mixture containing bismuth, potassium bicarbonate, and morphine. All are improving slowly. In 5 of these cases there was no pyloric obstruction. In 3 of them no ulcer was found at the operation.

The total, therefore, in this series of cases is 209, with two deaths; there are 4 patients who were not benefited by the operation in the least, and 10 who are relieved to some extent only.

What are the lessons to be learnt from this series? Briefly, I think, the following:

1. "Neurotic" cases are unsuited to operation. These patients have what may be called "sensitive stomachs"—that is to say, food, instantly upon its entrance, causes pain. There is no interval of comfort after food, of a quarter to two or three hours' duration, as is invariable in gastric ulcer. Their complaints, moreover, are vague, uncertain, apt to vary. If, therefore, a neurosis of this sort be suspected, but because of doubt the abdomen be opened, then, if no definite organic mischief be discovered, the abdomen should be closed without any short-circuiting operation being performed.

2. Patients who have pronounced hyperchlorhydria before operation should be treated by alkalies, etc., afterwards, and the supervision of the diet continued for a longer period than is necessary in ordinary cases.

3. If ulcer be at the pylorus nothing better than the operation of gastro-enterostomy can be practised. In cases of definite pyloric obstruction, gastro-enterostomy gives results which may be compared favourably with the results of any operation in surgery.

4. Ulcers on the lesser curvature, away from the pylorus, not causing obstruction, should, if possible, be excised. If adherent to the liver or the diaphragm, the adhesions should be broken down, the ulcer excised, and probably gastro-enterostomy also performed.

5. Ulcers in the duodenum, at or near the pylorus, should be infolded and buried by suture as is done when perforation has occurred. This is especially necessary in duodenal ulcers, for perforation of these has been observed after gastro-enterostomy. The infolding of an ulcer is easier than excision and quite as effective.

6. Adhesions affecting the body of the organ should be separated, especially when they affect the abdominal wall, the diaphragm or the liver. Even if adhesions re-form they are not so likely to distort and drag upon the stomach as are those caused directly by ulceration.

7. Chronic inveterate dyspepsia is due in the great majority of cases to conditions interfering with the proper mechanical action of the stomach. It should be treated by operation.

CLASS 4.

Summary and Analysis of Cases of Hour-glass Stomach.

The 22 cases are made up of 7 males and 15 females.

In every case there had been previous symptoms pointing to chronic gastric ulcer.

In 2 cases the history is strongly suggestive of a former perforation, while in a third case the urgency of a perforation indicated operative measures.

The *total mortality* is 3,—

One on the fourth day, from septicæmia resulting from a strangulated rectal prolapse.

One in the third week from suppression of urine.

One on the fifth day from pneumonia.

The ulcer in the stomach was associated with duodenal ulcer in 2 cases (one male and one female).

In 1 case a pancreatic cyst was also found at operation. Adhesions to the anterior abdominal wall were met with in 4 cases.

Trilobed stomach was seen once.

The following operations were performed:

Gastro-enterostomy alone, 7 times; 1 death, 6 cures.

Gastrogastrostomy and gastro-enterostomy, 3 times; 2 cures, 1 great relief.

Gastroplasty alone, 7 times; 5 cured, secondary operations were necessary in 2; gastro-enterostomy gave complete relief.

Dilatation of stricture, once; cure.

Gastroplasty and gastro-enterostomy twice; 1 death.

Gastrogastrostomy alone once; cure.

Gastro-enterostomy and Loreta's operation once; the patient died.

Results:

22 cases, 3 deaths.

2 secondary operations (gastro-enterostomy) for return of symptoms.

1 secondary operation (entero-anastomosis) for regurgitant vomiting after gastro-enterostomy.

One patient has since died of puerperal fever. The remaining patients are all living; all are completely cured except one, who, though very greatly improved, still has occasional discomfort after food. This patient had an hour-glass stomach and an hour-glass duodenum, there being four pouches and three constrictions.

CHAPTER XV.

THE OPERATIVE TREATMENT OF CANCER OF THE STOMACH.

THE success attained in the surgical treatment of cancer of the stomach has lagged behind that which is obtained in cancer of all the other organs in the body, with the possible exception

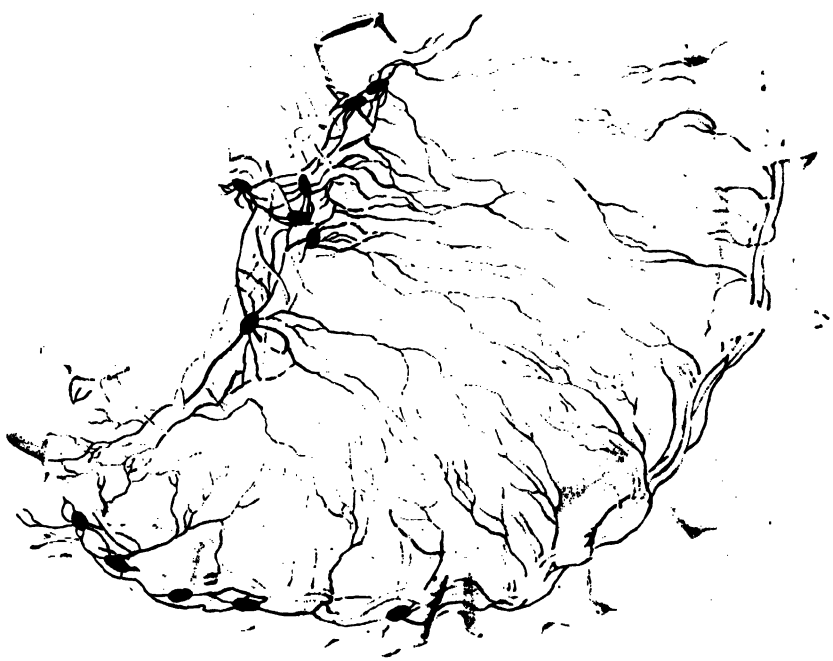


Fig. 80.—The lymphatics of the stomach (after Cunéo).

of the uterus. The mortality of all "radical" operations upon the stomach has been large, and until the last three or four years the essential principles which should underlie our action in dealing with cancer whenever occurring have been strangely ignored.

But brighter days are in store. Owing to the great work of Cunéo upon the lymphatics of the stomach, of Borrmann and Cunéo upon the pathological anatomy, and of Mikulicz, Rutherford Morison, and the Mayos of Rochester, Minnesota, upon the surgery, of cancer of the stomach, the results of treatment, based as they are upon accurate knowledge, are steadily improving. The contributions of Dr. W. J. Mayo to the literature of this subject are of the very highest merit; a careful study of them is incumbent upon any surgeon interested in this work. His recent results are vastly better than any that have been obtained elsewhere. Of the many most valuable additions which Dr. W. J. Mayo and Dr. C. H. Mayo have made to our surgical knowledge I think that none rank higher than their work upon carcinoma of the stomach. (See "Annals of Surgery," vol. xxxix, p. 321).

CANCER OF THE PYLORIC PORTION OF THE STOMACH.

The researches of Borrmann and Cunéo have shewn that the most common point of commencement of carcinoma in the stomach is 2 to 4 cm. from the pylorus, on or near the lesser curvature. From this point the disease spreads gradually, but more rapidly and to greater extent, towards the body of the stomach than towards the duodenum. On the stomach side, the growth is not equal in all directions. There is a pronounced tendency for the induration to spread towards the curvatures. As a rule, both curvatures are affected almost equally. In an examination of 63 specimens Borrmann obtained the following results:

In 32 cases both curvatures were equally affected.

In 7 cases the lesser curvature was more extensively affected.

In 19 cases the greater curvature was more extensively affected.

In 3 cases only the lesser curvature was affected.

In 1 case only the greater curvature was affected.

In 1 case both curvatures were free, the body only being affected.

Lebert gives the following table to shew the relative frequency of affection of the various regions of the stomach:

Pylorus	54	per cent.
Lesser curvature	16	" "
Cardia	9	" "
Anterior wall	3	" "
Posterior wall	4	" "
Both walls	4	" "
Greater curvature	4	" "
Diffuse	6	" "

Towards the duodenum the spreading is slower and invariably less extensive. From Rokitansky to Cunéo all investigators have emphasised the fact of the integrity of the duodenum. Invasion of the duodenum, however, does occur to a slight extent, as shown by Carle and Fantino, and must be reckoned with when an ideal operation is planned. If sections are made at the edge of a malignant neoplasm and the slides examined, the following condition will be found: The edge of induration corresponds to the limit of growth in the mucosa. In the submucosa the growth extends much further in a solid, unbroken mass; beyond the edge of this mass isolated nodular deposits of growth extend, becoming smaller as their distance from the tumour increases. The subserous and the serous coats are implicated approximately to the same extent as the mucosa. In removing any growth, the section of the stomach must, it necessarily follows, be made very wide of the indurated edge. The growth in the stomach may contract adhesions to surrounding parts, more especially to the liver and to the abdominal wall. These adhesions are a matter of grave importance for two reasons: firstly, they are channels along which the spreading of the disease is apt to occur, and, secondly, they afford a considerable embarrassment to the surgeon during removal of the growth. Haberkant, in his statistics, assesses the mortality of partial gastrectomy when adhesions were present at 73 per cent.; when no adhesions were found, at 20 per cent. Adhesions may occur between the growth and the transverse

colon. In an otherwise favourable case this need not hamper the surgeon. I have successfully removed the greater part of the transverse colon with the stomach, and the patient is still alive and free from recurrence nearly two years after the operation.

Adhesion to the pancreas is a most serious matter. It renders the operation difficult and increases the danger enormously. Mikulicz has stated that his mortality in cases of gastrectomy in which the growth was adherent to the pancreas is 70 per cent. as compared with 20 per cent. in other cases.

More important, however, than the extent of the obvious in-

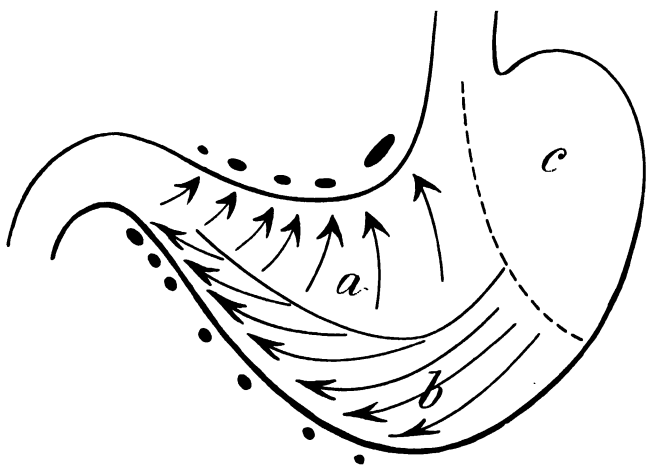


Fig. 81.—The lymphatic areas of the stomach: *a*, The area from which the lymphatic vessels drain into the coronary glands; *b*, the area from which the vessels drain into the glands along the greater curvature; *c*, the "isolated" area.

vasion in cases of cancer of the stomach is the question of the extent of the infection of the lymph-vessels and glands; for it will often be found that when a section of the stomach, some distance from the palpable disease, is made, the lymph-vessels in the parts that remain may be found to be widely affected when examined microscopically. The results, so far as the surgical treatment is concerned, may, therefore, readily be surmised; local recurrence will be confidently anticipated. It is, as a fact, from local recurrence that the majority of patients die.

Lymphatics of the Stomach.—The lymphatic glands of the stomach are situated chiefly along the vessels.

1. *Coronary Group.*—This chain is placed along the lesser curvature of the stomach, in close approximation to the coronary artery. The number of the glands is very variable. They are continued upwards along the coronary artery as far as its origin from the cœliac axis, and there become continuous with the glands along the upper border of the pancreas. One or two small glands lie over the termination of the œsophagus.

2. *The hepatic group* is placed along the hepatic artery and reaches up to the liver; some of its members lie along the pyloric artery.

3. *The glands of the greater curvature* lie along the right gastro-epiploic artery. At the pylorus they are numerous and close together, and pass behind the stomach to the head of the pancreas, and upwards towards the hepatic group. The glands do not extend along the whole length of the greater curvature, but are limited, approximately, to the pyloric third. The lymphatics of the left gastro-epiploic artery transmit their vessels to the hilum of the spleen.

The lymphatic vessels draining into these glands pass very obliquely in the walls of the stomach.

We may, therefore, describe three chief lymphatic areas of the stomach:

(*a*) An area along the lesser curvature from which the lymphatic vessels pass upwards and to the left into the coronary glands. This area occupies approximately two-thirds of the breadth of the stomach.

(*b*) An area along the greater curvature from which the lymphatic vessels pass downwards and to the right into the glands of the greater curvature. This area occupies the remaining one-third of the breadth of the stomach.

(*c*) An area, comprising the greater tuberosity of the stomach, extending up to the œsophagus, and on the greater curvature as far as the limit of the supply of the left gastro-epiploic artery.

If these statements are correct, it would naturally be expected that in cases of malignant disease beginning in the pyloric half of the stomach the growth would extend in the direction of the curvatures, and that the glands along the curvatures would be affected, whereas the greater tuberosity of the stomach and the glands which drain it would escape. An examination of a large number of specimens bears out this supposition. Indeed, the third lymphatic area (*c*) of the stomach may be looked upon as an area apart; therefore, an area whose lymphatic vessels and glands remain healthy even when disease is advanced elsewhere. For this reason I suggested for it the term "isolated area."

The following points then have been demonstrated:

1. Malignant disease of the stomach commences most often near the pylorus, just below the lesser curvature.

2. From its point of origin it spreads most widely in the submucosa, and chiefly towards the cardiac end of the stomach.

3. On the duodenal side it spreads tardily and never extensively.

4. The drift of the growth is towards the curvatures—chiefly the greater curvature.

5. The lymphatics draining the affected area pass to glands situated along the coronary and pyloric arteries above, and the right gastro-epiploic and the gastroduodenal arteries below.

6. The lymphatic vessels which run in the wall of the stomach upwards to the left and along the lesser curvature, and the glands into which they drain, are infected at an early stage of the disease.

7. The invasion of the lymphatic vessels and glands extends far beyond the edge of the growth along the lesser curvature; whereas, owing to the different direction in the current within the lymphatic vessels along the greater curvature, the lymph-vessels here are not widely invaded.

8. The greater tuberosity of the stomach is practically never involved by the spread of growth from the pyloric end. The difference, therefore, between the lesser and the greater curva-

tures, as far as the conditions in malignant disease are concerned, is this: that on the side of the lesser curvature the growth itself is often not so extensive as on the side of the greater curvature, but the lymphatic invasion and the glandular enlargement, owing to the different disposition of the vessels and glands, are far more extensive on the lesser curvature than on the greater.

In order to ensure complete removal of the primary growth, of the possibly infiltrated lymphatic vessels, and of the glands into which those vessels drain, it will, therefore, be necessary to

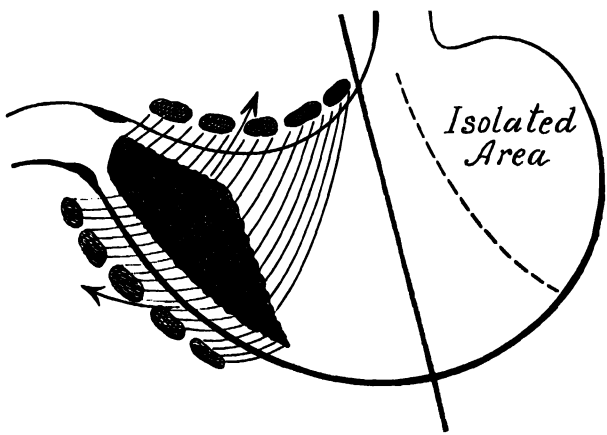


Fig. 82.—Diagram to shew the mode of spreading of a pyloric cancer, the lymphatic invasion, and the line of division of the stomach in partial gastrectomy. Note especially that the whole of the lesser curvature is removed. The arrows indicate the direction of the lymphatic currents.

remove the stomach as far up on the lesser curvature as the point of abutment of the coronary artery, and on the greater curvature as far as the termination of the right gastro-epiploic artery, and to remove the first portion of the duodenum.

This must be done unwaveringly in all advanced cases, especially in those cases where the greater curvature is largely involved. In early cases of growth affecting the pylorus a less extensive removal can safely be adopted. A reference to the diagram will shew that the vessels which drain into the glands

along the greater curvature run from left to right. In an early case they are never extensively affected.

Cunéo's researches shewed that almost two-thirds of the greater curvature of the stomach remained long unaffected in carcinoma of the pylorus. Hartmann, appreciating the enormous importance of this observation, at once pointed out that in the greater number of cases demanding operation a large portion of the greater curvature of the stomach could, therefore, safely be left. The ease and simplicity of an operation are thereby greatly enhanced, and, as might be expected, the mortality is reduced by something like 50 per cent.

The usual operation, therefore, will include removal of the growth, of the whole of the lesser curvature, including the glands in the gastrohepatic omentum, of about one-third or perhaps one-half of the greater curvature with the glands which lie along it, and of the first inch of the duodenum. The point on the greater curvature selected for the division of the stomach must be well away from the margin of the disease.

The following are the details of the operation of **partial gastrectomy** for **carcinoma of the pyloric portion of the stomach:**

The abdomen is opened through a central incision about two inches in length. Through this small opening two fingers are passed into the abdomen and the conditions of the growth are accurately determined. If the growth is movable, not intimately adherent to the liver or pancreas, and if no secondary growths are present, resection is at once decided upon, and the incision is rapidly enlarged to six or seven inches. If, on the contrary, the conditions are deemed inoperable, the abdomen is closed at once. It is well to have a long opening, for otherwise the hands may be cramped during the manipulations which are to follow. I have not found it necessary to make an additional transverse incision, as is done by Professor Hartmann.

The stomach and duodenum being freely exposed, a large number of flat swabs wrung out of hot sterile salt solution are placed in the abdomen, so as to shut off the operation area from

the rest of the peritoneal cavity. Two layers of swabs are used, as in all abdominal operations. The outer layer, which is first introduced, consists of the largest-sized swabs. To place them properly in position it is necessary to raise up the abdominal wall and to drag the stomach gently away from the part into

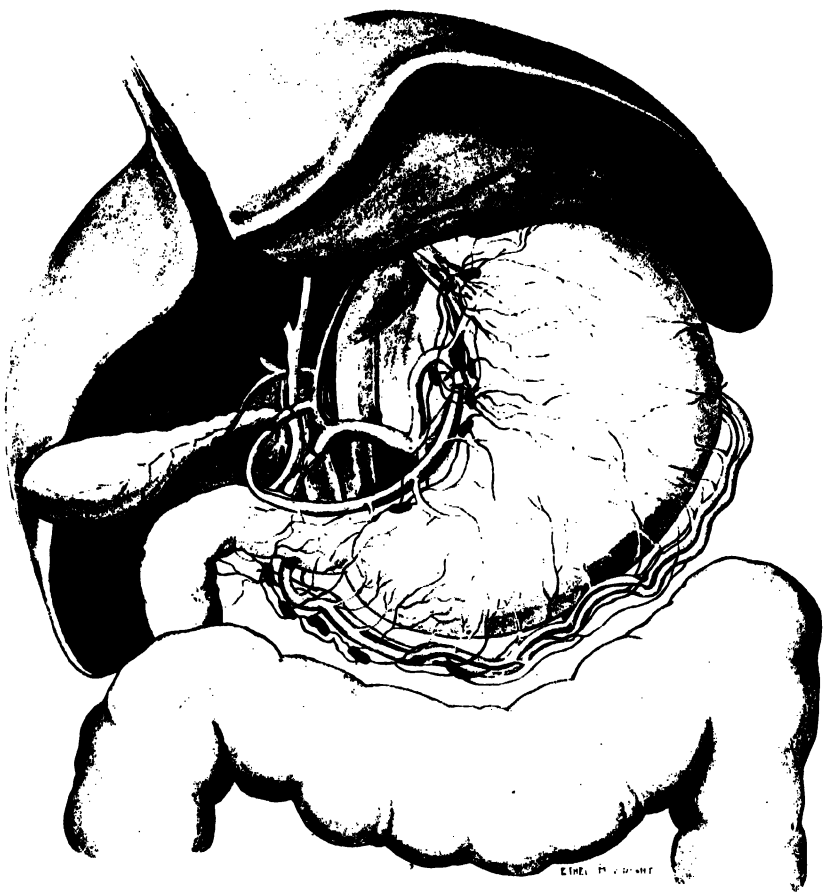


Fig. 83.—Partial gastrectomy. Preliminary ligation of the coronary, pyloric, and gastroduodenal vessels.

which the swab must be placed. When four or six of these are placed, a few smaller ones may be put in position. These are to be changed frequently as soon as soiled; the outer layer should remain undisturbed, until near the completion of the operation.

The first step in the operation is the ligation of the coronary artery. This vessel is secured as it approaches the lesser curvature of the stomach at its highest accessible point. In order



Fig. 84.—Partial gastrectomy. The vessels ligated; the gastrohepatic omentum tied off; the clamps applied to the duodenum.

so to ligature it, the stomach is pulled well downwards until the upper part of the gastrohepatic omentum is made taut and the liver is forcibly elevated by the hand of an assistant. The vessel can then be seen or felt. It is surrounded by a catgut

ligature (No. 4) passed in a large curved intestinal needle. The ligature embraces not only the artery, but also a small piece of the gastrohepatic omentum —the falx coronaria—which enfolds

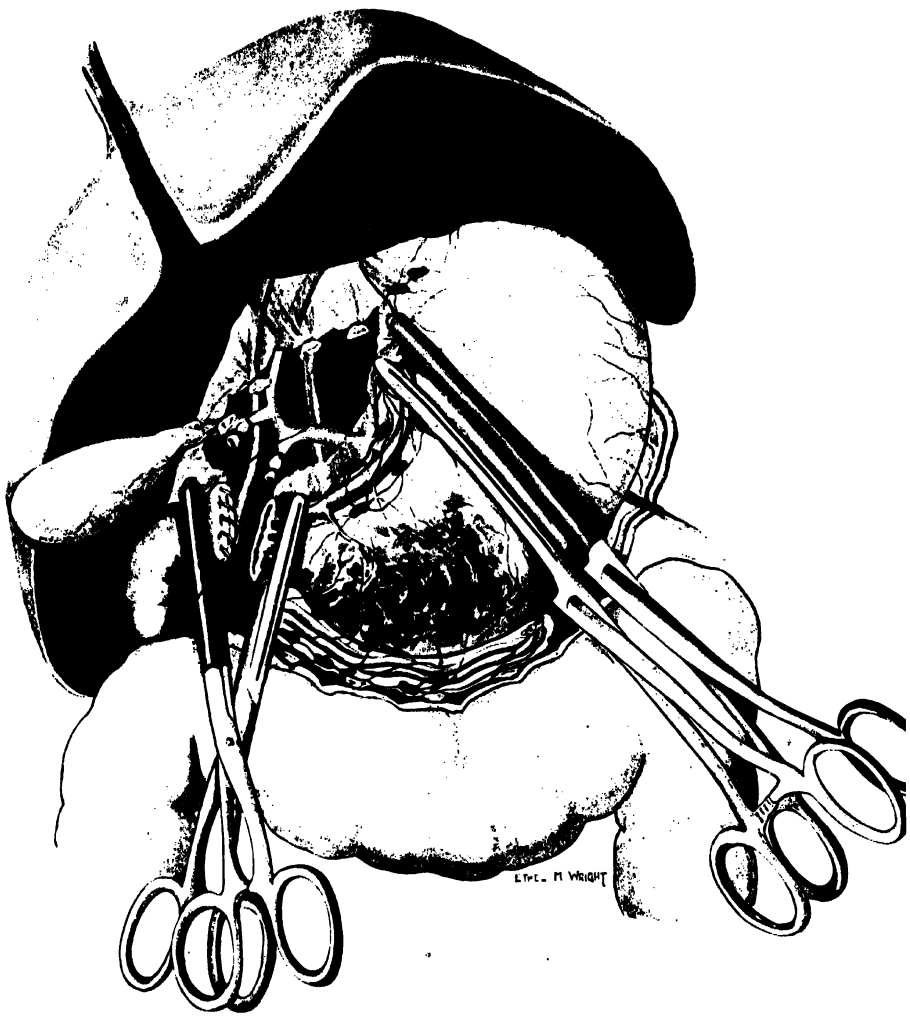


Fig. 85.—Partial gastrectomy. The duodenum divided between two clamps. The distal end closed by a continuous suture over a purse-string suture.

it. The needle is passed with a double thread, the two portions of which are pulled apart and ligatured at least one-half inch from each other; the vessel is cut between them. The incision thus made in the gastrohepatic omentum is continued just on to

the lesser curvature of the stomach at the point where the section of the viscus is afterwards to be made. The upper cut end of the vessel retracts a little towards the œsophagus. In placing the ligature on the artery it is desirable to make sure that

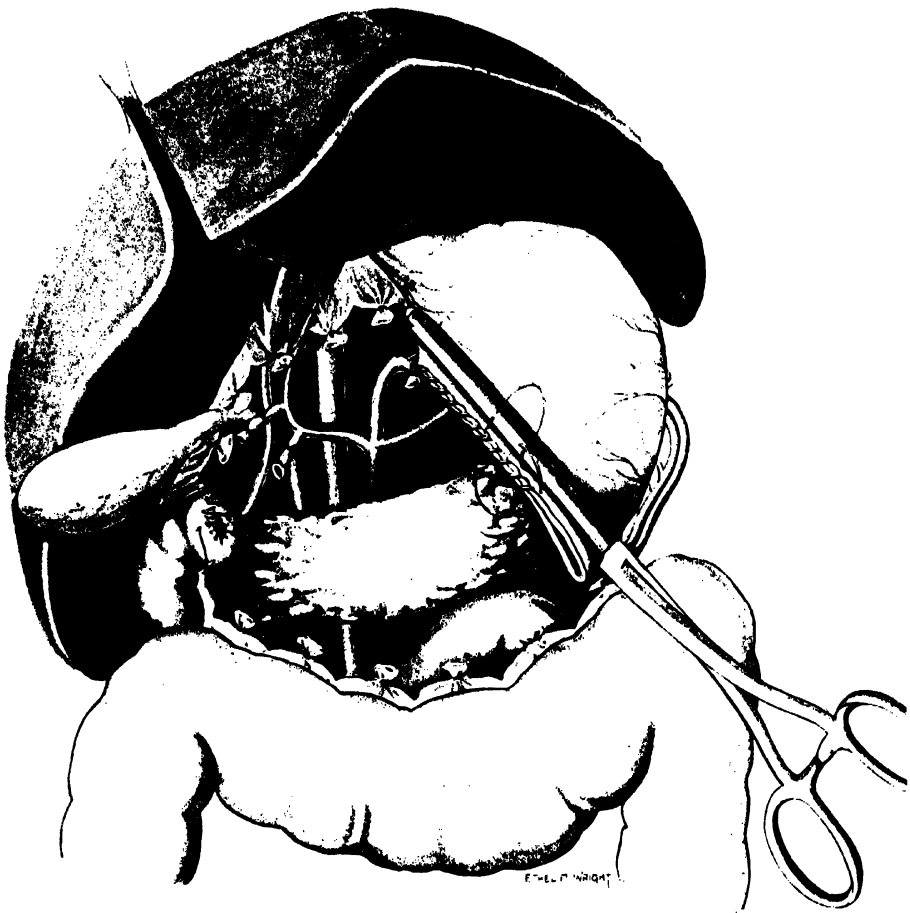


Fig. 86.—Partial gastrectomy. The duodenal opening almost closed; closure of the incision in the stomach.

it lies below the point of origin of those branches of the main trunk which are given off to the lower subdiaphragmatic portion of the œsophagus.

The gastric artery being safely ligatured, the gastrohepatic omentum is divided as close to the liver as possible, along a line

which extends from the small incision already made by the division of the artery to the duodenum. In many cases the gastrohepatic omentum is extremely thin and it tears through readily, even unexpectedly. If it is thicker it is ligatured off



Fig. 87.—Partial gastrectomy. The operation completed. The position of the posterior gastro-enterostomy opening is shewn.

in two or three bundles; a large curved intestinal needle armed with catgut being passed to secure a portion, which is at once ligatured and divided. When these bundles have been secured the upper part of the pylorus will be reached, and it is here that the superior pyloric artery is ligatured. This vessel may

be taken alone, or the occasional common trunk for it and for the gastroduodenal may be secured. If the vessels come separately from the hepatic trunk, as is the rule, the superior pyloric alone is taken, the ligature of the gastroduodenal being left till the duodenum is divided.

When this vessel is secured by a catgut ligature, a couple of fingers of the left hand are passed behind the stomach in order to free any adhesions which may perhaps exist between it and the pancreas. In doing this the most delicate manipulation is desirable, for damage to the pancreas may otherwise be inflicted. Such injury, though not perhaps as serious as Mikulicz and others have asserted, is still a thing to be avoided. In stripping the stomach here, a few vessels may be seen in need of ligature.

When the lesser curvature and posteror surface of the stomach are free, two or three hot moist swabs are packed above the lesser curvature into the lesser sac so that the posterior wall of this sac is completely protected.

The left index finger is now passed from above the pylorus behind the first portion of the duodenum and is made to project at its lower border. The finger is then pushed through the great omentum here, at a point about one inch beyond the pylorus. Along the track occupied by the left index finger two pairs of clamps are now passed upwards side by side. The distal clamp is rubber-covered; the proximal, about one-half inch away from it, has naked blades. When both are securely placed, the duodenum is divided between them. The proximal clamp is pressed home as tightly as possible, but in the subsequent manipulations it may possibly be loosened. To prevent this, a couple of stitches are passed above and below through all the coats of the duodenum and are tied over the clamp. This clamp is now wrapped round with hot moist gauze, so that contact with its cut mucous surface is impossible.

The distal cut end of the duodenum may now be closed, or if it is thought that subsequent union of it to the posterior surface

of the stomach will be possible, it may be left for the present securely wrapped in a hot moist gauze swab. It is my custom always to close it, as I prefer to make a separate gastro-enterostomy between the remnant of the stomach and the jejunum. The closure of the duodenum may be effected by a double layer of sutures, one through-and-through, taking all the coats, the other a seromuscular suture; or the cut end may be surrounded by a purse-string suture and infolded, a supporting serous suture being then applied.

The stomach which has been freed along the lesser curvature and at the duodenum can now be lifted well out of the abdomen, and the subsequent manipulations easily performed. The next step is to secure, if this has not been already done, the gastro-duodenal artery. To do this the clamp on the duodenum is pulled forwards and to the left to raise up the pylorus from the pancreas behind. The vessel is then found in the pancreatico-duodenal recess. It is ligatured in two places and divided between.

The division of the great omentum is then performed; and of all the steps in the operation this is perhaps the one which calls for the greatest care, for it is at times difficult to avoid wounding the middle colic artery, and damage to this vessel involves the risk of gangrene of the transverse colon. The omentum must be cut through below the gastro-epiploic vessels, for it is along these that the glands lie, and the glands must be removed with the stomach. The omentum is secured in sections either at once by ligature with catgut, or by a series of forceps, one placed beyond the other. The parts gripped in each forceps are then separately ligatured. It is neater, and perhaps quicker, to display each portion to be ligatured upon the left index finger which lies behind the omentum in the lesser sac, to pass a curved needle around the part so made plain, and at once to tie and cut through the section. The next inch or so of the omentum is then displayed and similarly ligatured, and so on until that point on the greater curvature is reached which

has previously been determined upon as the limit of the resection. This being done, the whole mass of the loosened growth with the pyloric portion of the stomach is then taken in the left hand and held well forwards, so that both surfaces of the stomach are seen, while a large clamp (Kocher's special clamp, or my own stomach clamp) is applied from the lesser curvature just below the œsophagus to the greater curvature at the point which has been reached in the omental ligation. This clamp has its blades covered with rubber. It is closed sufficiently to ensure a firm grip upon the stomach. About half an inch beyond it a similar naked clamp is applied and pressed home as firmly as possible. Between these two clamps the stomach is now divided. At first the serous and muscular coats only are divided, back and front, and then subsequently the mucous coat. If the division of all coats is simultaneous the mucosa is apt to pout a little obtrusively. A difficulty is sometimes encountered at the lesser curvature at this point owing to its tendency to withdraw from the clamp. If it should offer to do this, a couple of clips may be placed upon it, distal to the clamp, or what is better, the through-and-through suture is started at once at this end.

The sutures which are now passed to close the stomach are two,—an inner, which is occluding and hæmostatic, embraces all the coats; an outer, which infolds the inner, is seromuscular only. The inner suture may be of No. 2 iodised catgut, or of Pagenstecher thread; the outer should be of thread. Both are passed with a curved needle. (Some operators here as elsewhere prefer a straight needle, but the curved needle, when one is accustomed to it, is the speedier.)

The inner suture commences at the lesser curvature, where it is securely knotted, and continues uninterruptedly to the greater curvature. I prefer the ordinary continuous through-and-through suture, for bleeding almost certainly occurs from the cut surface of the stomach when the clamp is loosened, and if the mucosa is infolded by a Connell suture the blood escapes

into the stomach; whereas, by the suture I use, the mucosa is not infolded but only apposed, and bleeding from it is at once perceived and easily arrested. The clamp is now loosened from the stomach and any bleeding points separately secured by a through-and-through stitch. The next point is to make certain that the upper and lower parts of the cut stomach are well infolded. This is not entirely easy, owing to the thickness and retraction of the stomach. I therefore, before beginning the outer continuous supporting stitch, usually pass a Halsted suture at the extreme upper end, and sometimes also at the extreme lower end of the incision. When the edges at these parts are well rolled in, the continuous Dupuytren linen stitch is passed from the lesser to the greater curvature. The stomach when now inspected shows a suture line extending from within half an inch of the end of the œsophagus to the greater curvature; the line of section seems a direct continuation downwards from the right margin of the gullet.

At this point in the operation it only remains to complete the continuity of the alimentary canal by joining the stomach and the intestine together. This may be done in one of two methods:

1. By Billroth's second method; that is, by performing gastro-enterostomy.
2. By Kocher's method, which consists in uniting the cut end of the duodenum to the posterior wall of the stomach.

I prefer and have always practised the former, though the latter method has its able and successful advocates. By "Billroth's second method" a separate anastomosis is made between the stomach and the jejunum. This method is best carried out by performing gastro-enterostomy in the manner described elsewhere. Posterior gastro-enterostomy is better than the anterior, and the simple suture should always be used.

If Kocher's method is adopted, the duodenal cut end, which will not have been closed, is attached to the posterior surface of the stomach along a line distant about one inch from the cut

edge. The apposition of the two is rendered much easier by the "mobilisation" of the duodenum, suggested by Kocher. When the gut is freed in this way, it can be brought across the



Fig. 88.—Division of the stomach on the cardiac side has been performed, and the portion of stomach to be removed has been turned over to the right side, to allow of the ligation of the gastroduodenal artery (Hartmann).

middle line and attached to the stomach without tension. In order, however, to lessen this tension, sutures should be placed

in the great omentum at the lower border of the stomach and duodenum. Additional stitches around the anastomosis (which has been made in the usual manner by a double line of sutures) may be necessary.

The whole operation area is now inspected, the soiled swabs

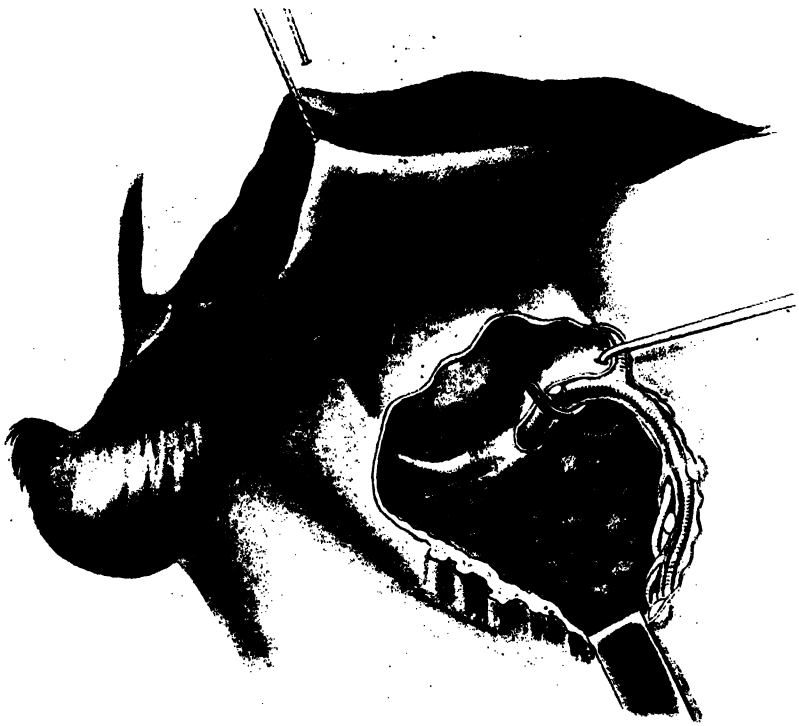


Fig. 89.—Ligation of the coronary artery (Hartmann).

are removed and counted, and all the parts gently sponged. If the patient's condition be poor a stomach tube may be passed, the end of which goes through the gastro-enterostomy opening onwards into the jejunum. The patient's head is then raised, and while the surgeon is stitching up the parietal wound, a couple of pints of peptonised milk with eggs, plasmon, sanatogen, or brandy, may be given with conspicuous advantage.

If there is any shock after the operation, continuous saline infusions or continuous rectal injections, after the method of Murphy, may be given.

This is the method generally to be adopted. It may be modified in certain particulars.

In two recent cases I have performed the gastro-enterostomy first, before proceeding to remove the growth. This has certainly proved an advantage, for the manipulation of the stomach has been easier. The anastomosis is made in the usual manner, but, of course, care is taken to ensure that the opening is well on the proximal side of the line along which the division of the stomach has to be made. Before anything else is done, this line must be accurately determined. When the stomach clamp is applied, before the division of the stomach, it is necessary to see that it does not lie too close to the anastomosis.

Hartmann divides the stomach before the duodenum. He begins by ligating the coronary artery and the gastrohepatic omentum. Two large clamps are then applied, and the stomach is divided between them. The distal segment is then turned well over to the right, and in the pyloropancreatic angle the gastroduodenal is easily found and ligated.

Throughout the operation the utmost nicety must be displayed. Everything should be done as cleanly and swiftly as possible. If the steps above described are carefully followed, there will be very little bleeding. If any vessel is seen to bleed, it should be instantly secured, for no drop of blood should be needlessly lost. The most scrupulous care should be taken to see that no contamination by the mucosa of the stomach or duodenum is possible. All instruments which come in contact with either are at once discarded, swabs are changed, and, if need be, the gloves of the surgeon and his assistant.

The operation should be performed in about an hour. There is little shock, as a rule, when no blood is lost and when care is taken to keep the patient warm and to prevent exposure of the

abdominal viscera. That surgeon will have the best results who pays the closest attention to every little detail.

One point deserving of special reminder is the need for avoiding any damage to the pancreas. As Mikulicz has shewn, the

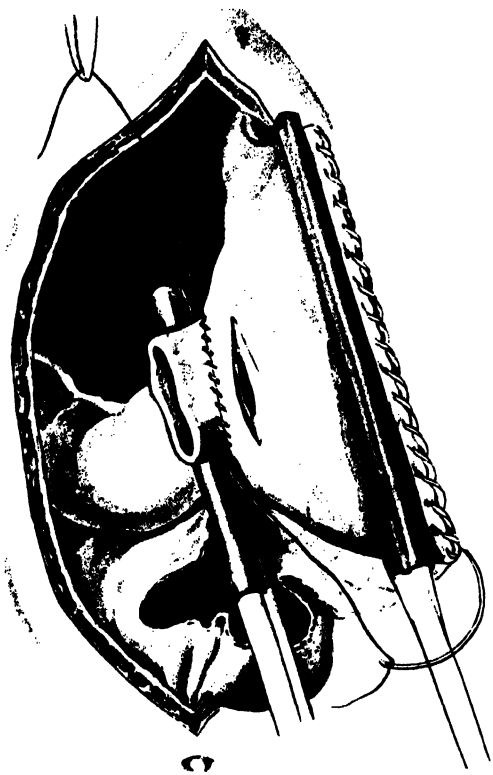


Fig. 90.—Kocher's method of uniting the duodenum to the posterior surface of the stomach after partial gastrectomy.

mortality in cases where any manipulation of the pancreas is necessary is far greater than in the ordinary case. The sensitiveness of the pancreas to trauma is well emphasised by this great surgeon in a paper published in the "Annals of Surgery," July, 1903.

At the completion of the operation the whole area is gently mopped with hot, moist swabs. No drainage is necessary.

The following is a brief epitome of the steps of the operation:

The abdomen is opened by a small incision in the middle line, through which an exploration is made. If resection is possible, the incision is rapidly enlarged until an easy view of all the parts can be obtained. Large swabs wrung out of hot sterile salt solution are packed around the operation area to protect the general peritoneal cavity from exposure or contamination. Over these large outer swabs smaller ones are placed which can be changed from time to time.

The coronary artery is found, exposed, and ligated in two places, and divided between them. The gastrohepatic omentum is ligated piecemeal as far away from the stomach as possible until the pylorus is reached. Here the pyloric and gastroduodenal vessels are exposed with the help of a couple of fingers in the lesser sac. The great omentum is then ligated beyond the vessels and glands, in bundles, until the point of division of the stomach at the greater curvature, which has previously been determined, is reached. Two pairs of clamps are now applied to the duodenum, and the bowel is divided between them. The distal end of the duodenum is closed by a ligature, reinforced by a purse-string suture and a continuous suture. Two pairs of large clamps are applied to the stomach along a line which extends from the beginning of the lesser curvature at the cardiac orifice to the point of division on the greater curvature. The stomach is divided between the clamps, and the growth, with the glands, is removed. The cut end of the stomach is closed by a double continuous suture, and any bleeding vessels are secured by an interrupted stitch. The stomach is united to the jejunum either at this stage of the operation or at the beginning of the operation. Scrupulous neatness is observed throughout.

I have never practised the immediate union of the duodenum to the stomach either by the first method of Billroth or by the method of Kocher. Indeed, I have never conceived it possible

to do this in any of the cases upon which I have operated. The free removal of duodenum and stomach has made an end-to-end approximation quite impossible. A desire to perform such an anastomosis must lead to an inadequate removal of the diseased area.

CANCER OF THE BODY OF THE STOMACH.

The above operation needs some modification in cases of cancer of the body of the stomach. In these cases the lymphatic involvement is more extensive than in those where the pyloric region alone is involved.

It is, therefore, necessary to perform the operation which I described in detail before the Clinical Society of London in November, 1901. (See "Clin. Society's Trans.," or "Brit. Med. Journ.," vol. ii, 1901, p. 1470.) By this method all the stomach except the "isolated area" is removed. The operation is carried out in precisely the same manner as that which has already been described, with this exception, that the point on the greater curvature chosen for the line of division is much nearer to the cardiac end of the stomach—it is, approximately, opposite the lower end of the spleen. Even in advanced cases of carcinoma of the body of the stomach the "isolated area" remains unaffected, and may, therefore, safely escape removal.

The operation is decidedly more difficult owing to this greater width of removal, for a part of the stomach only a little broader than two fingers alone remains: enough, that is to say, to form a sort of tube reaching from the œsophagus to the anastomosis which is made with the jejunum. The results of this operation are, however, satisfactory.

In some cases of hour-glass stomach due to malignant growth in the body of the organ the growth may be widely excised and an end-to-end suture of the stomach be performed.

CHAPTER XVI.

THE CHOICE OF OPERATION IN CANCER OF THE STOMACH.

In Pyloric Cancer.—Surgeons of some experience in operations upon the stomach are divided in their opinions as to the better operation in cases of malignant disease of the pylorus. On the one hand are those who, believing that a diagnosis of malignant disease cannot be made while yet the disease is local, advocate a palliative operation,—gastro-enterostomy,—with the idea of giving rest to the diseased area, and thereby retarding growth, as in colotomy for malignant disease of the rectum. On the other hand are those who, having been tempted to employ a radical operation in some favourable case or series of cases, are so impressed with its advantages that they become apostles of a broader creed and advocate local extirpation. My opinion emphatically is that, *in all cases, whenever possible, a radical operation should be attempted.* Under present conditions of diagnosis the probability is that, when a patient is submitted to operation, gastro-enterostomy is, in general, a safer operation than pylorectomy. But although the comfort and sense of well-being of the patient may improve very decidedly for a time after the former operation, the tumour is still slowly enlarging in size, and will eventually cause death. How much of the general ill health, cachexia, and so forth are induced by absorption from the growth, by necrotic changes in its mass, by ulceration and hæmorrhage upon the surface, is quite unknown, but one may presume that such influences are not trivial. Krokiewicz and Pilliet believe, indeed, that cancer cachexia is the result of intoxication with the by-products of metabolism of the cancer-cells. A local extirpation, then, even if followed by a recurrence, will probably prolong life for a greater period and in greater comfort than a gastro-enterostomy. It

was doubtless an opinion similar to this which led Terrier to remark that "the best form of gastro-enterostomy was done after removal of the pylorus." But increasing experience in the most competent hands tends to shew that in properly selected cases pylorectomy is *not* an operation of very grave risk, and *is* an operation of generous promise.

Partial gastrectomy in the early days of its employment was an exceedingly serious operation, with an appalling death-rate. Latterly the mortality is seen to be a gradually, but persistently, diminishing one.

In order to form some estimate as to the chances of life, of the condition of health, and of the relative values of different operations in patients afflicted with malignant disease of the stomach, it is desirable to enquire closely into the records of a number of cases, preferably in the practice of one surgeon, observed over a series of years. The fullest account of the surgical side of the question has been given by Krönlein, of Zürich, and by von Mikulicz, of Breslau. The questions that are in urgent need of settlement are the following:

1. Will a palliative operation upon the stomach prolong life?

2. Will it make the remnant of life more tolerable? Will it make the patient feel that the ordeal of operation is justified in the greater comfort of his later days?

3. Will a resection give a reasonable prospect of cure?

4. Will a resection, if followed by recurrence, give increased length of days and better health?

It is necessary, in fact, to know whether, in the stage in which we now meet with the cases, an operation is worth doing, and, if it is, whether it should be palliative, or whether an attempt should be made to eradicate the disease.

In order to have some means of comparing the surgical cases with those not operated upon, it is necessary that exact details should be kept of all cases coming to the surgeon, whatever their destiny—to operation, to internal medication, or to absence of treatment—may chance to be.

Krönlein tabulates the cases which came under his observation from April 1, 1881, to February, 1902. All the cases were recorded, without exception. There were 264, and the following table gives a brief sketch of their classification:

A. NOT OPERATED UPON.

1. Inoperable	53
2. Refusing operation	14
Total	67

B. OPERATED UPON.

		Death Under Operation.
1. Exploratory laparotomies	73	7— 9.5 per cent.
2. Gastro-enterostomies	74	18—24.3 " "
3. Gastrectomies	50	14—28.0 " "
Total	197	39—19.8 " "

Of the 264 patients, all but 13 were traced. Of these 13, the majority had not been treated by operation, and not one of them had been submitted to gastrectomy.

The fate of these patients is shewn in the following table:

Not traced		13
Dead		229
In consequence of operation	39	
Later, from intercurrent disease	2	
" from suicide	1	
" from the primary carcinoma	166	
" from recurrence after gastrectomy	21	
Living		22
Gastro-enterostomies	9	
Gastrectomies	13	
Total		264

Of the 264, it will be seen that 67 were not operated upon (25.3 per cent.). In 53 of these an operation was contra-indicated; in 14 it was refused by the patients.

Of the 264, 73 had exploratory laparotomy performed (27.6 per cent.). After the surgeon had opened the abdomen and had become convinced of the impossibility of radical extirpation, the abdominal wound was closed.

Of the 73 patients, 7 died within the first week after operation

(4 from exhaustion, 2 from pneumonia, and 1 from pulmonary embolism).

In 74 patients gastro-enterostomy was performed. At first sight this number appears small, but Krönlein has laid it down as a rule of his practice that in cases of carcinoma of the stomach, where extirpation is impossible, the palliative operation of gastro-enterostomy shall not be performed unless there is evidence of stenosis. If this evidence fails, the operation becomes merely "exploratory." The only exception that has been made is in those cases in which there has been marked stagnation of food without evidence of stenosis. Of the 74 gastro-enterostomies, 18, or 24.3 per cent., died under the operation.

Fifty patients were submitted to the operation of gastrectomy. Of these, 14 died in direct consequence of the operation. Of the total 264 cases, therefore, only 18.9 per cent. underwent the radical operation. One of the 50 was the well-known case of total extirpation of the stomach performed by Schlatter.

The subjoined table shews the percentage in which each form of operation was attempted:

264 CASES.

No operation in	25.3 per cent.
Operation in	74.7 " "
Exploratory	27.6
Gastro-enterostomy	28.0
Gastrectomy	18.9

OPERATION MORTALITY.

Exploratory laparotomy	9.5 per cent.
Gastro-enterostomy	24.3 " "
Gastrectomy	28.0 " "

In order to obtain a comparison between the life-chances of those patients who survive operation and those who are not operated upon, it is necessary to cancel the following:

Patients who withdrew after examination	13
" " did not survive operation	39
" " died of intercurrent disease	2
" " committed suicide	1
Total	55

Deducting these 55 from the total of 264 we have 209 patients, who may be classified thus:

A. NOT OPERATED UPON.

1. Inoperable	51	
2. Declining operation	12	63

B. OPERATED UPON.

1. Exploratory laparotomy	58	
2. Gastro-enterostomy	54	
3. Gastrectomy	34	146
Total		209

The report as to these 209 cases at the beginning of March, 1902, when these enquiries were concluded, was as follows:

Died from carcinoma of the stomach	187
Living	22

There died:

A. OF THOSE NOT OPERATED ON.

1. Inoperable cases	51	
2. Declining operation	12	63

B. OF THOSE OPERATED ON.

1. All the exploratory laparotomies	58	
2. Of the gastro-enterostomies	45	
3. Of the gastrectomies	21	124
Of those operated on and not operated on		187

There are still living:

1. Of gastro-enterostomies	9	
2. Of gastrectomies	13	22
Total		209

The duration of disease in patients suffering from carcinoma of the stomach was also reckoned. It was found that, on the average, the time from the first onset of symptoms up to the day of the patient's admission to the hospital, or up to the day of operation, was from eight to nine months. Means were also taken to discover the number of days from the patient's admission or from the date of operation to the patient's death.

The duration of time from entrance into hospital (time of operation) to date of death:

A. In the non-operated cases..... 102 days.
B. In the operated cases:
   1. Exploratory laparotomies..... 114 "
   2. Gastro-enterostomies..... 193 "
   3. Gastrectomies..... 520 "

If in these groups we sum up the values found for both periods of duration of the disease, we gather the following to be the average time for the whole duration of the carcinoma from the onset of the first symptoms until time of death:

A. In the non-operated, 9 months and 102 days—about 12½ months.
B. In the operated cases:
   1. Exploratory laparotomies, 9 months and 114 days, or 13 months.
   2. Gastro-enterostomies, 9 months and 193 days, or 15½ months.
   3. Gastrectomies, 9 months and 520 days, or 26½ months.

Krönlein, from this experience, draws the following conclusions:

1. That carcinoma of the stomach without operation has a fatal termination in about a year.

2. That gastro-enterostomy prolongs the life of the patients suffering from this disease for about three months, on the average.

3. That gastrectomy, so far as it is followed by recurrence, prolongs life on an average about fourteen months.

At the time this report was published there were 22 patients still living after operation. Of these, 9 were cases of gastro-enterostomy and 13 of gastrectomy. The former will, of course, prove fatal within a few months. So far as the latter are concerned, their length of life since operation is shewn in the following table:

1 case	is	in the	eighth	year	since	gastrectomy.
1 case	"	"	fourth	"	"	"
2 cases	are	"	third	"	"	"
3	"	"	second	"	"	"
6	"	"	first	"	"	"

Von Mikulicz, in 1901, published the results of his experience from April, 1891, to March, 1901. During this period 458 cases of cancer of the stomach had been under observation in the clinic at Breslau. This number includes 46 cases of cancer of the cardia. The diagnosis was confirmed either at the operation, or by observation of the progress of the disease, or by examination after death. In several cases of cancer of the cardia the diagnosis was confirmed by œsophagoscopy or by the removal and examination of a small portion of the growth. In 128 cases no operation was performed, chiefly because radical removal was no longer possible, and because there was no indication for any palliative procedure, such as gastro-enterostomy. In exceptional cases the operative interference was declined by the patient. The total duration of life from the commencement of the disease (as inferred from the symptoms in 67 cases in which it was possible to ascertain the facts) varied from a few months to 38 months—an average of $11\frac{1}{5}$ months.

In 320 cases recourse was had to operation as follows:

1. Simple exploratory incision 44
2. Gastrostomy (in cancer of cardia) 27
3. Jejunostomy 12
4. Gastro-enterostomy 143
5. Resection of stomach 100
6. Extirpation of stomach 3

Exploratory Incision.—Four deaths followed this operation, giving a mortality of 9 per cent. The average duration of life after operation was $4\frac{8}{10}$ months, and from the beginning of the disease, $14\frac{8}{10}$ months. If the cases submitted to exploratory laparotomy be added to those in which no operation was performed, we get an average duration of life of a little over 13 months from the beginning of the disease, a figure which is adopted by the author as a basis for judging of the results of the operative treatment of gastric cancer.

Gastro-enterostomy.—There were 48 deaths in 143 cases—a mortality of $33\frac{1}{10}$ per cent. Although during the last three years the mortality has been reduced to $26\frac{1}{2}$ per cent., it is still very

high in proportion to the same operation in non-cancerous conditions. The average duration of life after operation was $6\frac{4}{10}$ months, and from the beginning of the disease, 14 months; but if the operation deaths are included, this is reduced to $12\frac{3}{10}$ months, slightly shorter than the duration of life when no operation is performed.

Resection of the Stomach.—There were 37 deaths in 100 cases. In the last three years the death-rate has been reduced to 25 per cent.; that is to say, a mortality slightly lower than that of gastro-enterostomy. The results, as observed in 58 patients who survived the operation, and whose subsequent history is known, are as follows: 20 are still alive between 6 months and $8\frac{1}{4}$ years:

Longer than	1 year,	17	are alive.
" "	2 years,	10	" "
" "	$3\frac{1}{2}$ years,	4	" "

These last four may be regarded as radically cured. The author regards these results as quite as good as those after operations for cancer of the tongue or rectum.

It will thus be seen that there is no great divergence in the results taken from the two clinics, allowing for the fact that the number of cases in the one is almost double that in the other, while the period covered by the observations is only one-half. Krönlein records 264 cases extending over 21 years; von Mikulicz, 458 in 10 years. The results may be compared in this way:

	Krönlein. Months.	Mikulicz. Months.
The non-operated cases lived, from the beginning of the disease	$12\frac{1}{2}$	$11\frac{1}{5}$
The cases treated by exploratory laparotomy	13	$14\frac{3}{10}$
The cases treated by gastro-enterostomy	$15\frac{1}{2}$	14
The cases treated by gastrectomy	$26\frac{1}{2}$	$24\frac{1}{2}$

A careful study of the wealth of experience laid bare in these records will enable us more clearly to formulate our ideas as to the principles that should guide us in dealing with this most serious disease. In the first place, it must be admitted that our means of obtaining cases sufficiently early are almost as meagre as it is

possible for them to be. Until more accurate methods of diagnosis are established, it is absolutely imperative that recourse should be had earlier and more often to the exploratory laparotomy. At present that operation is limited to the examination of patients when the diagnosis has been made, and when the only question to be settled is whether or not the growth is removable. But in order to better our results we must explore, not to *confirm*, but to *make*, a diagnosis.

When the diagnosis has been made and the patient is submitted to operation, it is difficult to decide upon the exact surgical procedure which it is wisest to adopt. Von Mikulicz, Krönlein, and not a few other surgeons have spoken strongly upon the question of gastro-enterostomy, saying that this method should be adopted only in cases where stenosis, either at or near the pylorus, is caused, or in cases where stasis of food is marked. There can be no doubt that in such cases gastro-enterostomy is productive of the most remarkable benefit to the health and well-being of the patient. The weight increases, the appetite and the power of gratifying it return, and vomiting, often the most distressing and unceasing symptom, stops at once. But there can also be no doubt that in some instances, when the growth does not actually obstruct, by its bulk, the onward passage of food, a decided benefit results from the operation. The stomach is better and more quickly drained, and, as a rule, food can be taken more frequently and with greater comfort. In the majority of these cases, however, little or no benefit results from gastro-enterostomy. The position, therefore, may be thus briefly stated: If, after exploration, a growth is found to be obstructing the pylorus or to be narrowing the stomach and causing an hour-glass condition, or if stasis of food has been a marked symptom, then gastro-enterostomy will give very decided relief. If, on the other hand, the growth be confined to one or other of the curvatures, and if neither stenosis nor stasis be present, gastro-enterostomy will give little or no relief: it will not prolong life nor give a greater degree of comfort.

The operation of gastrectomy in the hands of von Mikulicz and of Carle and Fantino has given a lower mortality than gastro-enterostomy. Its advantages as compared with gastro-enterostomy are that it gives a greater prolongation of life—ten or eleven months longer—and that it affords a greater degree of comfort to the patient. Though recurrence may follow, yet in the majority of cases the patient is relieved greatly by the removal of a foul, ulcerating growth, from the surface of which an offensive and septic discharge is constantly occurring, and from which hæmorrhages, more or less copious, are often likely to take place. If, after removal of a malignant growth of the stomach, the surgeon will open the viscus and inspect the surface of the tumour, he will realise, when he sees the foul, ulcerous mass, that its removal cannot but be of vast benefit to the patient. It is true that in the great majority of cases the growth will recur either locally or generally; but the question may arise as to whether gastrectomy should not be performed deliberately as a palliative operation in cases where an early secondary deposit can be seen in the liver, or inaccessible or irremovable glands be found in the pancreas or along the aorta and vena cava. If we take into account the following advantages of gastrectomy as compared with gastro-enterostomy—that in the most competent hands its mortality is not greater, but is even less, than the mortality of gastro-enterostomy; that a prolongation of life for ten months longer than the period given by gastro-enterostomy is the rule; that the comfort, the general health, appetite, and well-being of the patient are all emphatically better; and, finally, that the patient has always a chance, even though it is of the slenderest, of a complete recovery from his disease—if we take all these into our consideration, there can be no doubt that the operation of choice will always be gastrectomy. Gastrectomy will be done always when a radical operation is attempted: it will probably be done often when nothing more than a palliative operation is intended.

If, after the abdomen has been opened, it is found impossible

or imprudent to attempt either gastro-enterostomy or gastrectomy, some relief may be obtained by performing duodenostomy or jejunostomy. The scope of these procedures is very strictly limited; but in rare instances, when the prolongation of life for even two or three weeks is of the greatest importance, then either of these operations can be done with propriety. The operations are simple, speedily done, and cause little or no shock, and they can, if need be, be readily performed with cocaine anæsthesia.

In Mural Cancer.—In these cases obstruction may be absent. Diagnosis is, therefore, not so early, so that when the abdomen is opened a large area of stomach may already be affected. Even if no narrowing is produced, a gastro-enterostomy, by determining rest, will assuage pain and lessen the rate of growth. A complete local removal, however, is the ideal for whose attainment we should strive.

The extent of such removal will vary from the minimum of an hour-glass stomach to the maximum of a general infiltration of both walls. The surgeon will be guided in a decision by the extent of such growth and by his personal capacity and preference. It is, I think, possibly open to question whether a complete gastrectomy is a scientific operation or a brilliant exploit in surgical gymnastics. The records of the cases so far performed are certainly far better than could have been anticipated.

In all cases of local excision, whether in the body of the stomach or at the pylorus, a wide healthy area surrounding the growth should be removed. Experience goes forcibly to shew that it is from local recurrence that patients die, even when the incisions have been made, as it would seem, wide of the disease. The direction of the spread of the growth should be carefully noticed. If the growth is spreading circularly in the line of the vessels, it shews little tendency to recur after removal; if it is spreading transversely along the curvatures, there is said to be a strong tendency to recurrence (Mayo). The importance of

Cunéo's observations, already referred to, may be again emphasised.

In Growth at the Cardiac End.—Only palliative operations are possible when the growth involves the cardiac orifice and the adjacent portion of the stomach. Levy has, indeed, planned an operation—and practised it upon the cadaver—for the purpose of removing such a growth ("Langenbeck's Archiv," 1898), but, so far as we know, a procedure of this kind has only once been attempted during life. This was by Mikulicz, who removed a primary carcinoma of the cardia and a portion of the œsophagus between 3 and 4 cm. in length. The operation was exceedingly difficult on account of spreading of the growth towards the pancreas and implication of the retroperitoneal lymphatic glands. The patient died of peritonitis. Mikulicz expresses the hope that not only carcinoma of the cardia, but even of the lower end of the œsophagus, may soon prove to be within the safe reach of a capable surgeon.

Krehl has shewn that in dogs the two pneumogastrics may be completely destroyed at the lower end of the œsophagus without interfering in any degree with the processes of digestion.

In all cases gastrostomy should be performed at the earliest moment after the diagnosis is assured.

ANALYSIS AND RECORD OF CASES OF CARCINOMA OF THE STOMACH TREATED BY THE AUTHOR.

The following is a record of my experience in the surgery of **carcinoma of the stomach:**

Since my first case on August 23, 1897, up to July 1, 1905, I have operated upon 59 cases of cancer of the stomach. The operations practised have been as follows:

Gastro-enterostomy	35 cases, 5 deaths
Anterior (all with Murphy's button)	7 cases, 2 deaths
Posterior (all with suture)	28 cases, 3 deaths
Gastrectomy	10 cases, 3 deaths
Complete	1 case, 1 death
Partial	7 cases, 1 death
Partial, with resection of transverse colon,	2 cases, 1 death

Gastrostomy, for carcinoma at cardiac end of the stomach	5 cases, 0 death
Jejunostomy	3 cases, 0 death
Exploratory laparotomy (operation not necessary or not possible)	6 cases, 1 death

During the same period I have seen 11 patients suffering from cancer of the stomach in so advanced a stage that I have advised against operation. One of these patients was operated upon elsewhere, and died six hours after gastro-enterostomy had been performed; of the remaining 10, 9 lived for periods varying from three weeks to fourteen weeks; in 1 no further history was obtained.

I propose to discuss the cases in the order already given.

Gastro-enterostomy. In the earlier cases I used the Murphy button, and performed the anterior operation. There were 7 cases and 2 deaths, 1 from shock and exhaustion in a very enfeebled and wasted patient, 1 from continued vomiting and exhaustion.

In the later cases I have performed the posterior operation by simple suture in the manner I have already described in detail. There were 28 cases with 3 deaths, 1 from pneumonia, 1 from shock or exhaustion, and 1 from septic peritonitis.

The value of the operation of gastro-enterostomy in malignant disease of the stomach has been variously estimated by surgeons. Recently a well-known London surgeon pronounced unhesitatingly against it in all cases; other surgeons are accustomed to practise it in all cases in which irremovable malignant disease is encountered. It has seemed to me that the indication for the operation is perfectly clear; it should be performed when obstruction to the food is caused (or is likely to be caused in its increase) by an irremovable growth at the pylorus, or in the body of the stomach near the pylorus. If no obstruction is caused, gastro-enterostomy is not indicated, and will not give, if performed, a degree of relief commensurate with the risks of the operation, though some temporary improvement may be noticed. If there is obstruction due to a growth which can be removed, gastro-enterostomy alone should not be performed unless the condition of the patient is such that the more serious operation of partial gastrectomy is not permissible. In

such circumstances gastro-enterostomy may be performed, and two or three weeks later, when the patient's condition may be much improved, the removal of the growth can be safely undertaken. A growth is considered irremovable when it is adherent over a large area to the pancreas (the result of injury to which is most serious), or when extensive adhesions, the presence of many enlarged fixed glands, or secondary deposits in the liver or parietal peritoneum, or elsewhere, make its complete eradication quite impossible. The extent of the growth in the stomach only and the enlargement of the glands along the curvature are negligible factors so far as the question of removal is concerned, for both are conditions surmountable by the operation which I now adopt.

A tumour growing on the lesser curvature well away from the pylorus may by its increase in size cause obstruction to the food. Gastro-enterostomy in such cases gives some measure of relief, though by no means as much as when the obstruction is due to an invasion of the pylorus.

The contrary to the rule mentioned is also in need of emphasis. It is that if obstruction is not caused, or is not likely to be caused, by the growth in its extension, the operation of gastro-enterostomy should not be performed; for the absence of obstruction implies that there is a free passage through the stomach to the duodenum. The making of a new opening is therefore clearly not necessary.

Duration of Life after Gastro-enterostomy.—I have not been able to trace the final stages in the history of all my cases. Of the 30 patients who survived operation, 20 have been traced to the time of their death; 6 are alive and well; of 4 nothing is known. The earliest death amongst these occurred in the fourteenth week after operation; the latest two years and four months after operation. The length of life in the series is as follows: Fourteen weeks, fifteen weeks, eighteen weeks, five months, five and a half months, six months, 1 between six and seven months, 2 between seven and eight months, 2 between eight and nine months, 3 between nine and twelve months, 2 between twelve and eighteen months, 2 between eighteen months and two years, 2 over two years. The patient who survived longest was a woman upon whom I operated on June 13, 1902, with Dr. Norman Porritt, of Huddersfield. Writing to me on October 27, 1904, Dr. Porritt said:

"You found pyloric enlargement and enlarged glands, and at the operation expressed the opinion that the case was one of malignant disease. The immediate recovery from the operation was very satisfactory, but convalescence was slow, and œdema of the legs coming on seemed to confirm the correctness of your opinion as to the nature of the case. But the patient went to Blackpool, and came back a different woman, and has been in first-class health until about five or six months ago. The leg œdema quite disappeared. About five or six months since she began to lose flesh and condition, a tumour appeared in the middle of the lower part of the epigastrium, and the patient went downhill, and died from malignant disease of the stomach two days ago."

Of the 6 patients who are still alive, 1 was operated upon thirteen months ago, and 5 within the last twelve months.

A question in reference to these patients that has to receive an answer is this: Is it worth the patient's while to have the operation done? I should answer, without hesitation, Yes. For in all such cases death is imminent and the remnant of life would be intolerable from constant vomiting, gastric intolerance, and the complete inability to take or enjoy food in satisfying quantities. By the operation of gastro-enterostomy life is undoubtedly prolonged, and, what is of far greater consequence, the last weeks or months of life are rendered tolerable. Food can be taken in fair and sufficient quantity and can be enjoyed; there is no stasis of food and there is no vomiting. Death occurs from gradual exhaustion, and ascites with or without jaundice may be a feature of the terminal condition.

Gastrectomy.—In the 9 cases in which partial gastrectomy was done, the growth was either "pyloric" or "prepyloric" in all. The tumour was largest at or near the pylorus, and thence had spread to the curvatures—to the lesser curvature in 7, to the greater curvature in 2. In the 7 former the lesser curvature was palpably affected in a considerable part of its extent, and the coronary glands were also enlarged; in the 2 latter the growth had spread very much more extensively along the greater curvatures, and had puckered up the transverse mesocolon and invaded the transverse colon, or caused its stenosis by kinking. In all the cases partial gastrectomy was performed—in the first

2 by the method I described before the Clinical Society of London in November, 1901; in the remaining 7 by the modification of it described above. Of the 9 cases, 2 died within a week of the operation, 1 in a few hours, 1 in three and a half days. Of the remaining 7, 1 has lived four and a half years and is quite well and free from recurrence; 1 died in eleven months with ascites, 1 in fourteen months with secondary growths in the liver and jaundice and ascites, and 4 are still alive, the operation having been performed at dates distant between two and a half years and five months.

In one patient complete gastrectomy was performed with a fatal result. I have elsewhere described this case in detail, and need not do more now than express my opinion that the operation is one which has a legitimate place in surgery, and is not merely a brilliant piece of surgical gymnastics. There is no doubt whatever about the fact that the whole of the stomach may be involved by a growth which has given rise to no secondary deposits; a growth which can, therefore, be entirely removed. In my paper in the "British Medical Journal" (1903, vol. ii, p. 1458) all the recorded cases are collected.

Gastrostomy.—In all cases the growth was at or near the cardiac orifice of the stomach and was causing stenosis. It is possible that in 3 of these, at least, the growth was primarily œsophageal, the cardia being affected by extension downwards of the disease. The operation was performed by Senn's method in 4, by Frank's method in 1. The patients lived five months, five and a half months, seven months, eight months, and seventeen months ofter operation.

Jejunostomy.—The patients lived four and a half weeks, eight weeks, and eleven weeks after operation. In all these cases the stomach was so involved that gastro-enterostomy was impossible, and the presence of secondary nodules in the liver or in the peritoneum put away any thought of excision.

The prolongation of life for eleven weeks in one case was a matter of considerable moment, the man being able to settle some affairs of the highest importance with his son, who at the time of the operation was in South Africa. But for the operation the patient could hardly have lived a fortnight.

Exploratory Laparotomy.—The opinion is, I fear, too often expressed that an exploratory operation in suspected cancer of

the stomach "to confirm the diagnosis" is almost entirely devoid of risk. This is far from being the case. In order to determine with accuracy the extent of the growth, and to know with certainty the possibility or otherwise of its removal, an incision three inches or four inches in length is necessary, and the hand must be passed within the abdomen. People who have obvious cancer of the stomach are often enfeebled, advanced in years, and possessed of but little reserve of strength. An exploratory operation is therefore in itself a matter of some gravity, and must not be heedlessly performed.

The incision which admits one finger only is enough for the very late or for the very early cases, but there are many cases lying between these extremes where a close scrutiny of the parts is necessary before an accurate decision for or against operation is possible.

Duration of Life after Exploratory Operations.—The exploratory operation has had, in two cases, a very marked and unexpected result. The symptoms of pain and distaste for food, or inability to take food, disappeared almost entirely for periods of two months and two and a half months respectively. The patients expressed themselves as feeling much relieved by the operation, and were better able to take food. The longest duration of life after exploration was just under seven months.

Non-malignant Growths.—In addition to the cases already discussed, I have operated three times for growths (in 2 at the pylorus, in 1 at the centre of the stomach) which I considered to be malignant, but which have been proved by their subsequent course to be simple in character. One of the cases was operated upon in June, 1900 (a patient sent to me by Dr. Clarke, of Doncaster), and the other in January, 1901 (a patient sent by Dr. La Touche, of Ossett). A case of hour-glass stomach due to supposed malignant growth in the body of the organ was operated upon in June, 1901 (sent to me by Dr. Crawford Watson, of Harrogate; subsequently under the care of Dr. Selkirk, of Boston Spa). These are 3 cases, therefore, in which simple inflammatory masses were mistaken for cancerous growths. In 1 case I have made the opposite mistake, a malignant growth being looked upon as a simple one. This patient lived fourteen months after operation, and died with ascites. A postmortem examination, was made, and a large mass of cancer discovered at the pylorus, with many secondary masses in the liver.

Postscript.—Between July 1 and December 31, 1905, I have in addition operated upon 8 cases of carcinoma of the stomach. Gastro-enterostomy was performed 6 times; all the patients recovered. Gastro-enterostomy, followed by gastrectomy, once successfully. Exploration once, the patient recovering. In 6 of these the growth was at or near the pylorus, and formed an obstruction to the onward flow of the gastric contents; posterior gastrojejunostomy was therefore performed. Three cases had already developed secondary growths; in 1 the patient's severe condition rendered the more radical operation unwarrantable, though the local conditions appeared favourable for excision; in 2 the extent of the growth and the number of adhesions prevented, in the patient's bad condition, any radical operation. In one case the gastro-enterostomy was made well away from the pylorus, and on the twenty-fifth day partial gastrectomy was performed. In one case the patient was found to have a growth of considerable extent involving the lesser curvature in its cardiac half, and adherent posteriorly to the pancreas. There being no pyloric obstruction, the abdomen was closed without further interference. This patient died in the tenth week after operation. Of the remaining patients, two have since died, one two months after operation; in his later days he suffered a good deal of pain, owing to the formation of numerous metastases, but to within a week of the end he was able to take food fairly well. The second patient died three and a half months after operation, with jaundice and ascites. The remaining patients are alive and in fair health. The histories of four patients suggest the previous existence of an ulcer upon which the terminal disease was engrafted.

In my first series of cases I have omitted to mention one case of carcinoma of the stomach in which perforation occurred. The opening was closed by suture and a flap of omentum stitched over; gastro-enterostomy was then performed. The patient recovered and is still living, eighteen months after the operation. He has now jaundice and ascites.

CHAPTER XVII.

GASTROSTOMY.

THE operation of gastrostomy consists in the making of an opening directly into the stomach, in cases of obstruction of the œsophagus or cardiac end of the stomach, for the purpose of introducing food directly into the interior of this organ. In the earlier cases it was found that the new orifice was not only an inlet, but also an outlet; that it permitted the free escape of food and gastric juice, and that, as a result of this, the skin around the opening became reddened and digested. The condition of the patients was often one of the most intense misery. The skin for four or five inches around the new orifice was intensely red, raw, and excoriated; it was excessively tender and sensitive, and the escape on to it of the acid gastric juice gave rise to the most intolerable smarting and burning pain. Measures were, therefore, devised for the purpose of making a valvular opening an opening, that is, that would permit the introduction of fluids into the stomach, while it prevented the escape of gastric juice or digesting food.

A large number of operations have been described, and practised with success, and the surgeon now has the choice of several methods, any one of which will serve his purpose fully.

In the great majority of instances the cause which determines the necessity for the operation of gastrostomy is malignant disease of the œsophagus. Simple or syphilitic stricture of the pharynx or œsophagus or malignant disease of the cardiac end of the stomach may also call for the performance of this operation. In cases of malignant disease of the œsophagus it is important that the most suitable time should be selected for the performance of the operation. It was formerly almost always the case that the surgeon was asked to operate when the patient was in the

last extremity of his illness, when he was unable to take any food, or, at the most, only a few ounces daily, and when his condition was so bad that the danger of the operation—in itself a perfectly simple matter—had become considerable. If a patient is first seen when in this deplorable state, it is most desirable that all means should be taken to improve his condition before the operation is undertaken. It will sometimes be found possible, though often perhaps difficult, to pass a small silk catheter through the stricture into the stomach. If this can be done, the catheter should be left in, its outer end being secured by a tape and strapping to the ear, the forehead, or the neck. Through the catheter several pints of nourishing fluids can be poured daily, to the evident improvement of the patient's condition. During a week, several pounds in weight may be gained and the fitness of the patient to bear the operation be greatly strengthened. In one patient who was almost starved to death I was able to keep a tube in for six weeks; during this time she gained 21 pounds in weight. Had I performed gastrostomy at first, the result would almost certainly have been fatal; as it was, the operation was borne without the slightest shock.

In all bad cases, therefore, feeding through an œsophageal catheter should be attempted before gastrostomy is performed.

It is important not to delay too long in the advocacy of operation. It is equally important not to be precipitate. The operation, though of the greatest benefit to many patients, is nothing more than a forlorn and final measure of relief to prevent starvation; to many, it must be acknowledged, it has something revolting in its methods. When a patient can take enough fluid food by the mouth to keep himself alive and in fair condition he is not a suitable subject for gastrostomy. Early operation and late operation are both to be condemned. The proper time for operation is when the patient is ceasing to be able to take enough fluid nourishment to keep up his weight and strength, and it is, therefore, before he has lost of both so much that his power of resistance to surgical treatment is greatly reduced.

The operation can be done quite easily in a few minutes under cocaine anæsthesia, but I prefer to give a general anæsthetic if it can safely be administered. The usual preparation of the skin is made. Owing to the great wasting of the patient, the abdominal wall shelves away steeply from the costal margin; the incision is made, therefore, through an abdominal wall which is more nearly vertical than horizontal.

A great variety of incisions have been suggested. Some are vertical and pass through the rectus, or the rectus is bodily pulled aside; others are in varying degrees of obliquity. The valvular action of the stomach at the new opening is effected in several ways. In my opinion the operations which are the most satisfactory are the following:

1. Senn's operation (E. J. Senn).
2. Kader's operation.
3. Witzel's operation.
4. Frank's operation.

1. **Senn's Operation.**—This is the operation which I have used for the last five years. It is, in my judgment, the best operation for these reasons: it is simple, speedily performed, effects a perfect valvular opening, and does not involve, as do some of the methods, a sacrifice of some part of a stomach already reduced in size for the purpose of forming a cone which is pulled through an incision in the abdominal wall to lie beneath the skin.

The operation is performed in the following manner:

A vertical incision is made over the left rectus muscle near its outer border, commencing a little below the level of the tip of the xiphoid cartilage and continuing downwards for about 2½ inches. The fibres of the rectus muscle are separated, not divided, and the peritoneal cavity is opened. If the separation is done with the finger covered by gauze, no nerves will be divided. The stomach is then sought and is easily recognised. It is said that the transverse colon has been mistaken for the stomach and has been opened; one would think that such a mishap is

impossible, for there is not the smallest resemblance between the two viscera. The stomach is generally found at once, but, owing to the fact that it is often thin-walled and shrunken from long suppression of its normal activity, it may lie flaccid and empty at the back of the stomach chamber, with the transverse colon in front of it. When the colon is displaced downwards, it comes at once into view. It is picked up, drawn forwards to the parietal incision, and a portion of it, as far removed



Fig. 91.—Gastrostomy (Senn's method). The stomach is opened and the tube fixed with a single stitch.

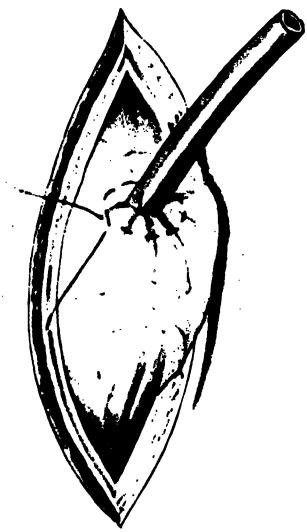


Fig. 92.—Gastrostomy (Senn's method). The first purse-string suture.

as possible from the pylorus, is selected for the operation. A point about midway between the lesser and the greater curvature is chosen for the site of the opening into the stomach. At this point a small incision is made with a scalpel of sufficient size to admit a No. 10 or 12 Jaques catheter or a piece of drainage-tube of about the same diameter. The catheter or tube is passed into the stomach through this opening for a distance of two to three inches, and is then fixed by a single catgut stitch which passes through all the coats of the stomach, at the edge

of the incision, and then picks up a portion of the tube. When this stitch is tightened, the tube is held fast and remains so held until the catgut is absorbed—or cuts through—in about ten days.

The tube so fixed is now buried in an inverted cone formed from the walls of the stomach by the insertion of three purse-string sutures. The first purse-string suture is applied in a circle whose centre is the tube, and whose radius is about half an inch. The suture picks up the stomach-wall at about six points. As it is tightened, the tube is depressed into the stomach



Fig. 93.—Gastrostomy (Senn's method). The first purse-string suture tied.



Fig. 94.—Gastrostomy (Senn's method). The second purse-string suture.

by an assistant whose other hand holds the stomach steady, so that when tied, the suture closely embraces the tube. A second suture is now introduced at a distance of half an inch from the tube, picking up the stomach-wall at seven or eight points. As it is tightened and tied, the tube is again pushed inwards so that the suture again embraces the tube closely. A third, and, if necessary, a fourth, suture can be similarly introduced. The result is that a cone of the stomach is inverted into the cavity of the organ; and in the centre of this cone there lies

the tube or catheter closely embraced by the outer wall of the stomach. The stitches are all tightened with sufficient firmness to embrace, though not to constrict, the tube. When the last stitch has been cut short, two sutures are passed above and below the tube in order to fix the stomach to the parietal peritoneum. These sutures include the posterior sheath of the rectus and the parietal peritoneum on each side, and pick up a broad strip of the stomach about ¾ inch distant from the tube. They serve to draw the stomach up to the parietal incision and to fix it there firmly. The incision is now closed by suture in the usual manner; a continuous catgut stitch picks up the parietal peritoneum and

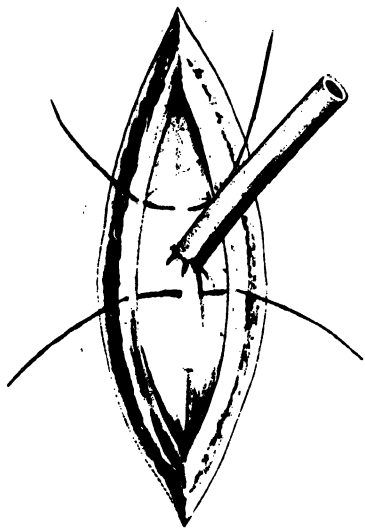


Fig. 95.—Gastrostomy (Senn's method). The purse-string sutures completed; fixation of the stomach to the anterior abdominal wall.



Fig. 96.—Gastrostomy (Senn's method). Shewing the invaginated cone and the line of the purse-string sutures.

the posterior sheath of the rectus, and, returning, picks up the

anterior sheath of rectus. Two stitches are used—one above and one below the tube. The skin is then sutured with silkworm gut.

At the conclusion of the operation the patient is fed: about ten ounces of warm milk, with egg or brandy, are introduced through the tube into the stomach. At the outer end of the tube a second India-rubber tube is attached, a piece of glass tubing about one inch in length forming the medium of attachment. A glass funnel fits on the outer end of this second tube, and into it the food is poured.

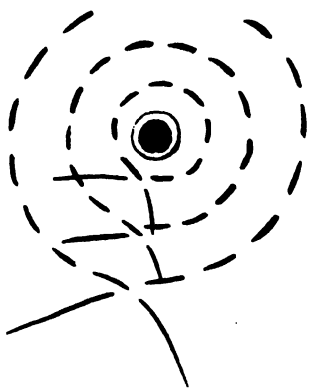


Fig. 97.—Gastrostomy (Senn's method). Diagram of the position around the tube of the purse-string sutures.

This method ensures an absolutely secure valvular opening. I have never known leakage to occur from the opening. At the end of ten or twelve days, rarely earlier, the tube will be found to be loose. It can then be removed and a second tube be introduced. It is better to keep a tube always in the opening, as, otherwise, there may soon be evidence of contraction, and the reintroduction of a tube may then be difficult.

A dressing is kept on the wound for the first fortnight, and is secured by an abdominal bandage. Through the dressing the tube passes, and its outer end is attached to the bandage by a safety-pin.

The condition of the patient may be so reduced that early and frequent feeding is necessary. The best food is warmed milk to which eggs or egg and brandy are added. Water should be given occasionally, and beef-tea or soups may afford a change. After a week or two of direct feeding the patient may find that he is again able to swallow thin fluids in small quantities. This

he should be encouraged to do, if no distress results, for the loss of the opportunity to *taste* food is often the most serious deprivation of which the patient complains. In some cases the patient may obtain satisfaction from masticating a little underdone beef, mutton, or some chicken or game, and feeding himself through the funnel or tube with the finely chewed food. If the patient will not, or cannot, use his mouth and teeth, great care must be exercised to keep them thoroughly clean. The teeth should be brushed three or four times daily, and the mouth well flushed with some fragrant mouth-wash.

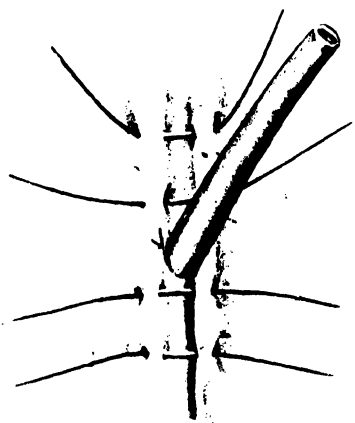


Fig. 98.—Kader's method of gastrostomy: tube fixed by a single stitch; a fold on each side is raised up by a Lembert suture.

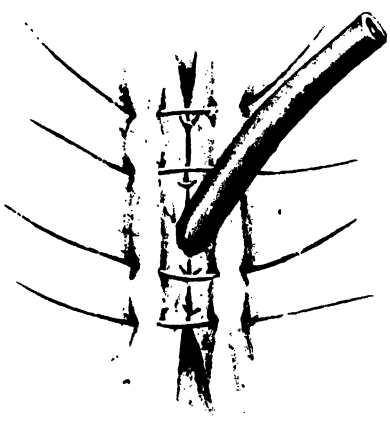


Fig. 99.—Kader's method of gastrostomy: first layer of sutures tied, second layer in position.

2. **Kader's operation** consists in the vertical infolding of a portion of the stomach by interrupted sutures passed above and below a tube introduced through a small incision. The tube is first secured by a single catgut stitch, as in Senn's operation. Two vertical parallel folds of the stomach are then raised up on each side of the tube by four or six sutures. When these sutures, which include only the serous and muscular coats, are tied and cut short, a further series are introduced which pick

up the stomach-wall on each side of the original line of stitches. On tying this second row the first row of sutures is buried. A reference to Figs. 98 to 100 will make matters plain. The stomach is then fixed to the anterior abdominal wall, as in Senn's method. It will be seen that by this operation exactly the same kind of valve is produced as by Senn's procedure. The advantages of the latter over Kader's operation are that the operation is more speedy, that it is simpler, that fewer stitches

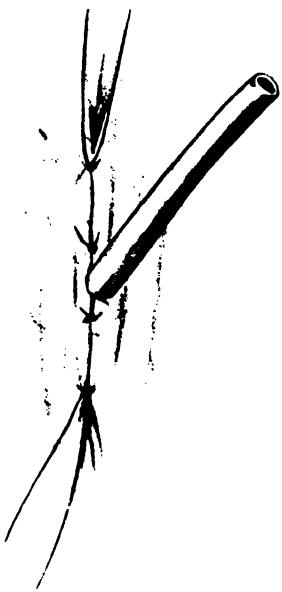


Fig. 100.—Kader's method of gastrostomy: second layer tied; fixation sutures left long.

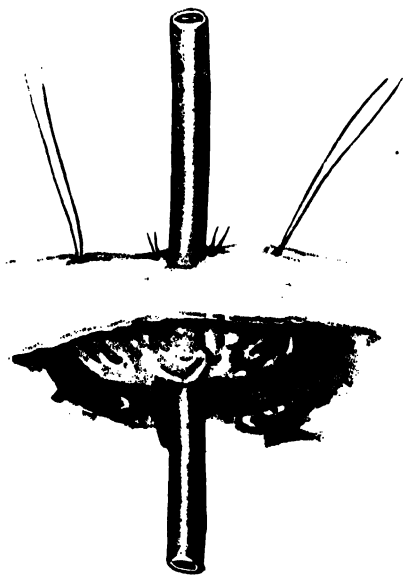


Fig. 101.—Kader's method of gastrostomy: the parts seen in section.

are required, and that a cone, instead of a cube, is made to project into the cavity of the stomach.

3. **Witzel's Operation.**—In this operation the stomach is brought into the wound, and opened by a small incision into which a tube is fastened by a single catgut stitch, as in the two operations just described. The tube when thus secured is laid against the anterior wall of the stomach and is buried in a sort of trough or gutter formed by raising up a fold on each side of

the tube. The summits of the folds are brought together over the tube by interrupted sutures. One or two sutures are passed beyond the end of the tube, so as to be sure that the opening into the stomach is also walled off. About two inches of the tube are thus covered in and made to lie in a sort of canal in the stomach-wall. Witzel himself recommends that a second layer of sutures should be introduced, but this is quite unnecessary.

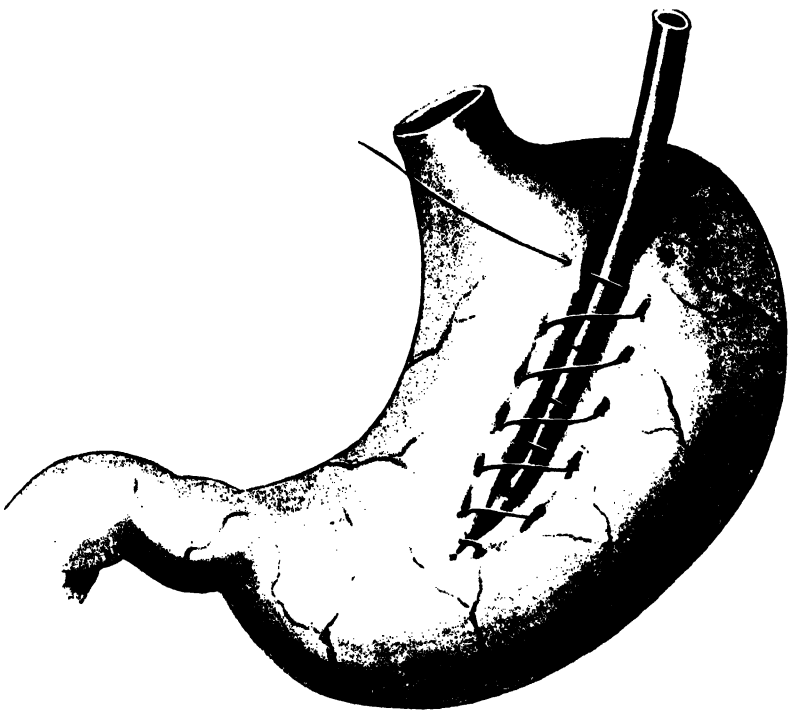


Fig. 102.—Gastrostomy (Witzel's method).

Marwedel has modified Witzel's method by passing the tube between the mucous and muscular coats for a couple of inches between the openings on the serous and mucous surfaces. There is no advantage in this.

Witzel's method proves most satisfactory in practice. Indeed, von Mikulicz, in an experience of 150 cases, is so satisfied with the results of both Kader's and Witzel's methods that he considers that there is no excuse for the introduction of more

complicated methods. I have used both and have found both to be good, but for the reasons I have already given I consider that Senn's operation is better than either.

4. **Frank's Operation.** This operation has received a great amount of support from many operators during the last few years. Though the results are good, they are no better than



Fig. 103.—Gastrostomy (Frank's method, as modified by Kocher). The whole of the rectus is pulled to the outer side.

those seen after any of the preceding operations (indeed, leakage has been occasionally observed), and they are obtained only after a more prolonged and more complex operation.

An oblique incision, about 2½ inches in length, is made parallel to the costal margin and about one inch from it, near the outer border of the rectus. The abdomen is opened, and

a cone of the stomach close to the cardiac end is then stitched, by four interrupted sutures or by a continuous suture, to the parietal peritoneum at the edge of the incision. A second incision is now made over the costal margin, about ¾ inch in length, at a distance of about one inch from the first incision. Between the two incisions the skin is undermined until the finger

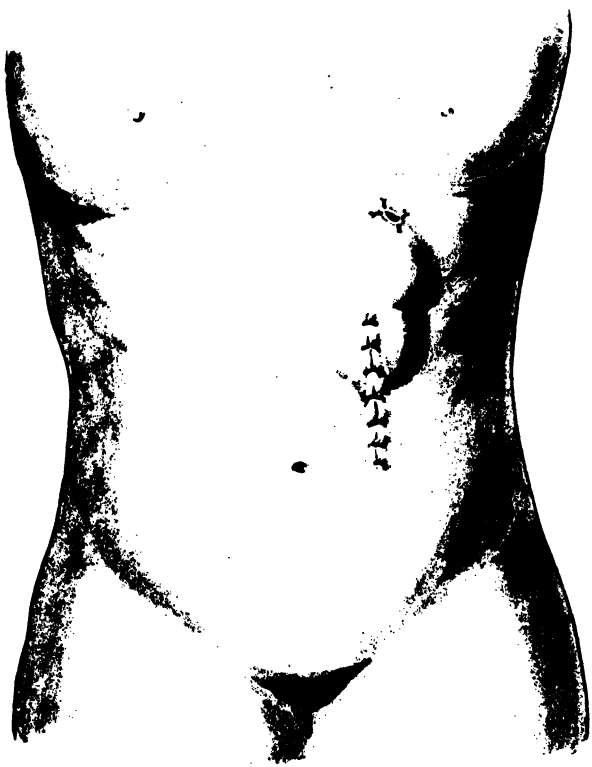


Fig. 104.—Gastrostomy (Frank's method). The operation completed.

can be passed through the one opening, beneath a bridge of skin, and out of the other. Beneath this bridge of skin the cone of the stomach is passed until its apex projects like a nipple from the second opening. Here it is stitched or is held by a pair of hare-lip pins, which transfix it. The original wound is now completely closed by suture. The tip of the stomach cone may now be opened, and a catheter passed into

the stomach, or the opening may be deferred for twenty-four hours or more.

As von Mikulicz and others have shewn, the original obliquity of the passage does not long persist; the tube, after a time, passes directly backwards into the stomach. To prevent this, as far as possible, the second opening must be made well over the costal margin, whence it cannot be dragged down to lie in front of the posterior opening.

This operation cannot be easily performed when the stomach is very much shrunken from long-continued emptiness. It is, moreover, under any circumstances, wasteful in the amount of the stomach which is used up by the formation of the cone.

CHAPTER XVIII.

JEJUNOSTOMY.

JEJUNOSTOMY is an operation that can be but rarely called for. It is suitable only for those patients suffering from advanced malignant disease of the stomach in whom, owing to the position, extent, or character of the growth, gastro-enterostomy or gastrostomy is deemed imprudent or impossible.

Indications for Operation. —(1) Extensive infiltration of the stomach with carcinoma, when there is little or no healthy stomach-wall that can be utilised for the purpose of gastrostomy.

(2) General cicatricial contraction of the stomach, simple in character, dependent upon the swallowing of caustic fluids.

(3) Neumann has suggested that in cases of pronounced hyperchlorhydria jejunostomy should be performed in preference to gastro-enterostomy. He points out that the intensely acid secretion of the stomach, passing into the jejunum through the new opening, may produce ulceration, which will rapidly destroy the intestinal wall and lead to perforation—that is to say, a peptic ulcer of the jejunum results, in a manner precisely similar to that occurring when a peptic ulcer of the first portion of the duodenum develops. Peptic ulcer of the jejunum is recorded by Braun, Halm, Kausch, Körte, Steinthal, Hadra and Neumann, and others. In four cases the ulcer caused death by perforation, and in all there was a great excess of free hydrochloric acid.

(4) Căckovie and others have suggested that in cases of persistent hæmatemesis rest might be afforded to the stomach by an artificial mouth in the jejunum. This plan has received the sanction and approval of Professor Mikulicz.

Several methods for the easy performance of the operation have been suggested. Only three are of value. The first was

suggested by Maydl; the second is the modification of Witzel's operation, which I was the first to suggest; the third is Mayo Robson's method.

Maydl's Operation.—In this operation the abdomen is opened

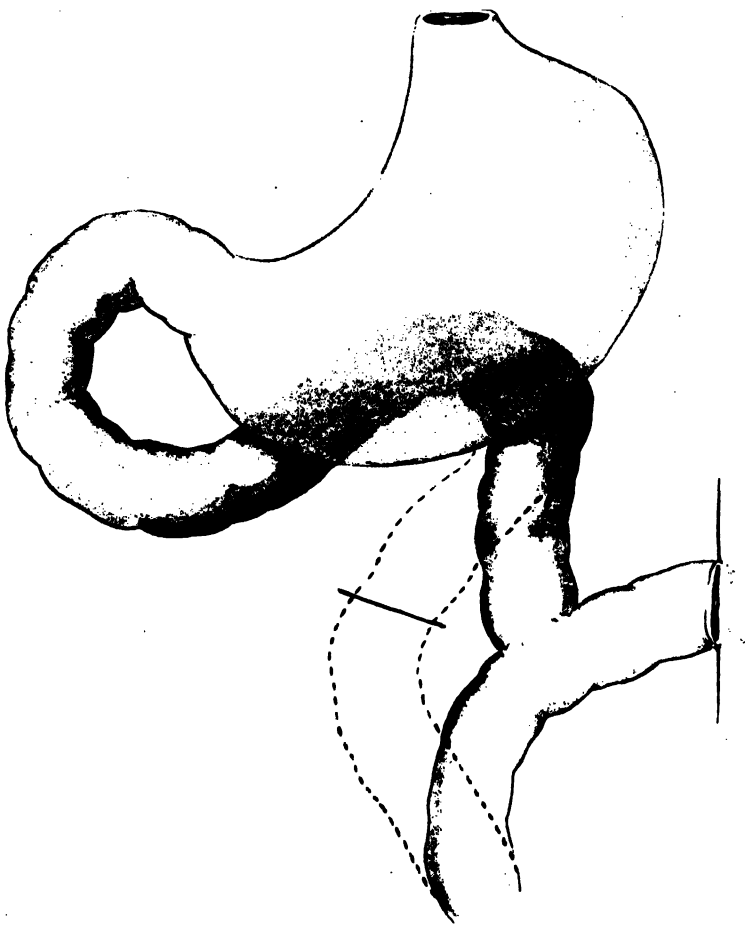


Fig. 105.—Jejunostomy (Maydl's method).

by a small incision through the left rectus muscle, and the upper end of the jejunum is sought. The bowel is cut completely across, and the proximal cut end is implanted into the side of the distal, a few inches from its divided end. The distal open end

is then stitched to the abdominal wall. The figure (Fig. 105) will explain the exact condition of things. The similarity of this method to that adopted in Roux's operation of gastro-enterostomy in Y is at once apparent.

Second Method. The following is the description of the method I carried out in my first case ("Brit. Med. Jour.," June, 1902):

The abdomen was opened a little to the left of and above the umbilicus, through the rectus muscle, whose fibres were

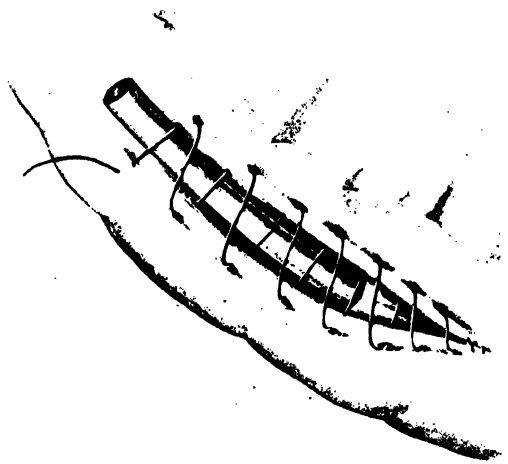


Fig. 106.—Jejunostomy (adaptation of Witzel's method as used by the author)

split. The duodenojejunal junction was sought, the jejunum traced downwards for six or eight inches, and a loop drawn out of the abdomen. On the side of this loop farthest from the mesentery a small longitudinal incision was made, opening the bowel, and a piece of drainage-tube about the size of a No. 12 catheter was introduced, and fixed by a single catgut stitch, which included the cut edge of the bowel and the side of the

tube. The tube was then laid along the bowel upwards towards the duodenojejunal flexure. A continuous stitch was now passed from side to side of the groove made by the tube, so that the tube, when the stitch was tightened, was buried by the overlapping of the edges of the groove. The stitch was begun about ¾ inch below the opening in the jejunum, so that any leakage there might be effectually prevented. About two inches of the tube were covered by the stitch, which was then tied and cut short. The line of suture in the bowel was then made fast to the anterior abdominal wall by a stitch at each extremity, and the abdominal incision was tightly closed around the tube, which projected for about ten inches.

When the patient is fed through such a tube, a funnel is fixed on to the end, and food poured in slowly. At the first only six ounces are introduced, but after the first few days up to a pint may be given in the space of ten minutes.

The opening in the jejunum is made, therefore, at approximately the point where Schlatter made the œsophago-intestinal anastomosis in his case of complete gastrectomy. It is clear from this case that enough food can be taken by the jejunum to enable weight to be gained and the general well-being of the patient to improve. If a jejunostomy were performed for any non-malignant condition of the stomach, the probability would be that, as in Schlatter's case, a decided increase in the capacity of the jejunum would be demonstrable, affording a reservoir for the food.

Mayo Robson's Method.—Mayo Robson has described (Trans. Roy. Med. Chir. Soc., 1905) a method of jejunostomy which depends upon the exclusion of a loop of intestine which is brought to the surface for the introduction of a tube. He writes:

"The operation I have performed, which I believe is new, consists in taking a loop of the beginning of the jejunum just sufficiently long to reach the surface without tension. The two arms of the loop are short-circuited about three or four inches from the surface, the short-circuiting being done either by means

of sutures around a decalcified bone bobbin or by sutures alone. Personally I prefer the former.

"A small incision is then made into the top of the loop just large enough to admit a No. 12 Jaques catheter, which is inserted and passed for three inches down the distal arm of the loop. This is fixed to the margin of the incision in the gut by a silk or a Pagen-



Fig. 107.—Jejunostomy (Mayo Robson's method).

stecher suture, and the entrance of the tube into the bowel is further guarded by two purse-string sutures, one over the other. The top of the loop is fixed to the skin by one or two stitches and the wound closed. The patient can then be fed at once with some peptonised milk and brandy. The whole operation can be done in from fifteen to twenty minutes and with very little viscera exposure.

"Should the patient be too ill to bear the little extra time occupied by the short-circuiting, the tube may be inserted as directed and surrounded by two or three purse-string sutures, a proceeding which can be accomplished in a few minutes. In this case the loop of bowel must not be brought to the skin, but had better be fixed by sutures to the peritoneal margin and the aponeurosis, in order to leave part of the lumen of the attached loop within the abdomen for the direct passage outwards of the intestinal fluid with the bile and pancreatic secretion."

The same variety of food may be given in jejunostomy as in gastrostomy; the staple article of diet should be peptonized milk. In some cases a duodenostomy may be preferred to gastrostomy. Hartmann has recently reported an example of duodenostomy for a cicatricial narrowing of the stomach following upon the swallowing of a caustic fluid. A duodenal mouth may be considered as more efficient than one opening into the jejunum, in that the food is introduced into the bowel at a point higher than the orifice of the ampulla of Vater. For the performance of this operation the second method above described is the most satisfactory.

CHAPTER XIX.

GUNSHOT WOUNDS OF THE STOMACH.

GUNSHOT wounds of the stomach vary greatly in character and in treatment, according to the nature of the weapon which produces them. In the South African War the rifles used by both the combatants delivered a bullet of small size, travelling with an extremely high velocity. The result was that there was a cleavage rather than an actual destruction of the tissues, and in those cases where a bullet traversed the abdominal cavity it was found that when the stomach or intestines were wounded, there was no leakage of the visceral contents, and that healing generally occurred without complication.

The lessons of this war, however, have no application in civil practice. The rude weapons of the suicide or the would-be murderer are often clumsy and uncertain. With them a larger bullet is used and the rate of velocity is very much less. There are, as a result, a large destruction of tissue and a crushing or bruising over a wide area. In addition to the perforation in a gunshot wound made by such a weapon there is a considerable amount of contusion and of rough damage to the immediately adjacent parts.

Sir Frederick Treves gave it as his opinion that it is inadvisable to operate in cases in which the abdomen is traversed above the umbilicus owing to the multiple character of the injuries; while the cases in which the abdomen is traversed below the umbilicus get well without operation.

Forgue and Jeanbrau ("Rev. de Chir.," September and October, 1903) have collected the notes of 112 cases of gunshot wound of the stomach in which the lesion was verified either at the postmortem examination or at an operation. In 64 of these cases the ball passed completely through the stomach,

wounding both surfaces. In some cases only one wall was injured, the ball remaining in the stomach, or passing, in one case, into the intestine. In other cases the bullet had struck a curvature and clipped a piece away.

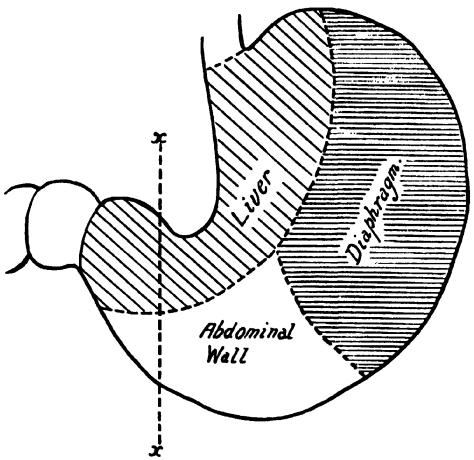


Fig. 108.—Relations of anterior wall of stomach (Testut).

Seven of the cases died of hæmorrhage, which was due generally to the wounding of a large arterial trunk, such as the coronary. In one case, related by Guinard as having occurred at the Lariboisière Hospital, an abdominal exploration was undertaken in a patient who presented no signs of injury except an abundant hæmatemesis. A very minute examination of the stomach was made, but nothing abnormal was found. The patient died, and at the autopsy the bullet was found free in the peritoneal cavity. It had not perforated any viscus, but on examining the interior of the stomach a wound of the mucosa close to the pylorus was found, of the size of a franc-piece. This was the source of the hæmorrhage.

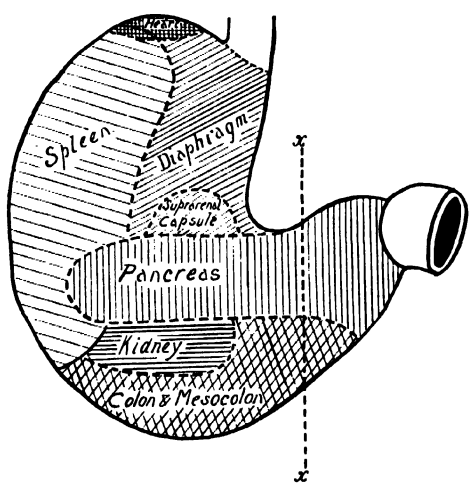


Fig. 109.—Relations of posterior wall of stomach (Testut).

Peritoneal infection depends upon the size of the wound and upon the state of repletion of the organ. If the stomach is full, and if vomiting occurs, the contents escape freely into the general cavity of the peritoneum.

Spontaneous recovery is possible. Socin records the case of a man who was shot in the abdomen. It was thought that the stomach was wounded, but the patient recovered without operation. Five months later he died of a "medical illness." At the autopsy two wounds of the stomach soundly cicatrised were seen. Spontaneous healing such as this depends upon the

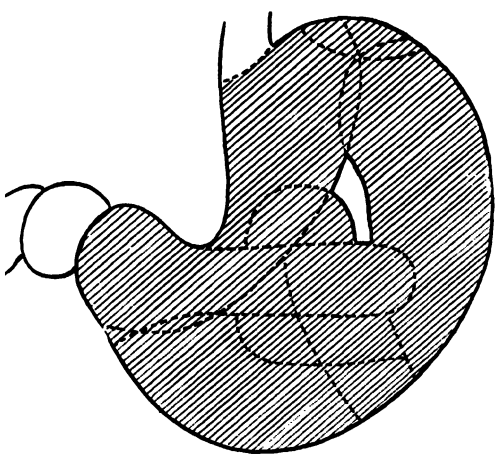


Fig. 110.—The two preceding figures superimposed. The unshaded area shews the only part of the stomach which can be wounded without injury being done to other organs (Forgue and Jeanbrau).

emptiness of the stomach, the small size of the wound, and the plugging of the wound by omentum, or upon the formation of a gastric fistula, which permits the instant escape of contents to the exterior, as in the oft-quoted case of Alexis St. Martin and in others related by Baudens, Cannizaro, and T. Smith.

In all cases of revolver or pistol wound—indeed, it may be said, in all forms of gunshot wound—of the stomach in civil practice, the abdomen should be opened with the utmost expedition. The records of the cases collected by Forgue and Jeanbrau shew that the mortality increases in direct proportion

to the delay. The result of their enquiries is shewn by the following table:

WOUND OF THE STOMACH ALONE, WITHOUT OTHER VISCERA.

	Recovery.	Death.
(*a*) Intervention within six hours	9	4 cases.
(*b*) Intervention without mention of time	2	4 "

WOUND OF THE STOMACH, WITH OTHER VISCERA.

	Recovery.	Death.
(*a*) Intervention within six hours	13	16 cases.
(*b*) Intervention within six to twelve hours	2	11 "
(*c*) Intervention after twelve hours	2	11 "
(*d*) Intervention without mention of time	3	5 "

In examining the stomach the utmost care should be exercised. The figures given by Forgue and Jeanbrau shew that it is not unlikely that some other damage will be inflicted by a bullet which traverses the stomach. Search for such an injury must be made, and any wounds so found must be appropriately dealt with. So far as the wound in the stomach is concerned, the edges must be trimmed or turned in by suture.

DETAILS OF THE OPERATION.

The usual preliminaries having been observed, the abdomen is opened by a free incision in the middle line above the umbilicus. In certain cases—in those, for example, in which the stomach is wounded near the cardiac orifice—a very free exposure may be necessary, and the median incision alone may be inadequate. Auvray has advised that in such circumstances a second incision should be made from the upper end of the central one, downwards and to the left along the costal margin, which may, if necessary, be partly excised. In all my operations upon the stomach, including a complete gastrectomy, I have never found the need of anything more than a central incision.

The abdomen being opened, a general inspection of the parts is made. There may be much blood-stained fluid and perhaps the contents of the stomach or intestine in the peritoneum. A rapid but efficient cleansing is then necessary. The stomach is then picked up with a piece of gauze, to ensure a firmer hold-

ing, and the whole of the anterior surface carefully and methodically inspected. A little bubbling of froth or the sizzling noise made by the escape of gas may be enough to direct attention to the wounded spot; or if a vessel of moderate size has been wounded, the continued escape of blood will direct attention to the point of injury.

If a wound on the anterior surface of the stomach be discovered, it should be closed at once by suture. As a rule, no excision of the edge of the rent is necessary, but if there be much contusion or fraying, then a free trimming away of the damaged wall may be necessary. If the opening be of sufficient size, it may be made use of for purposes of digital exploration or inspection before being sutured.

The wound is closed by a double layer of stitches, the inner including all the coats of the viscus, the outer only the serous and muscular coats.

The anterior surface having been made perfect, an examination of the posterior is necessary. This may be effected either by an opening through the gastrocolic omentum at the lower border of the stomach, as advised by Forgue and Jeanbrau, or by turning up the transverse colon and opening the transverse mesocolon.

There may or may not be a second opening of exit on the posterior surface, and such an opening may or may not be near, or opposed, to the anterior. The bullet which has injured the anterior wall may remain in the stomach, be vomited, be passed on into the duodenum, or may penetrate the posterior wall. The surgeon, however, cannot neglect to make the most scrupulous examination of the posterior wall, and if a rent be found therein, he must deal with it as with the anterior wound.

A search for other injuries must be made. It is remarkable how often they are overlooked. Forgue and Jeanbrau quote many cases where, at the postmortem examination, gross damages, overlooked at the operation, were laid bare. Bertram records a case where the spleen and the left kidney were found

injured; Briddon, one where four perforations of the small intestine were found; Gabzewicz, one where an injury to the colon was seen; and Poncet and others, examples of injury to the liver. The minutest search must be made despite the fact that, because of the patient's collapse from shock or hæmorrhage, a prolongation of the operation is not without its own danger.

In not a few recorded cases the movements of the surgeon are greatly hindered by the copious amount of blood-stained fluid in the general peritoneum. No sooner is the field of operation cleared than a slow oozing of blood or deeply blood-stained fluid causes further delay, by obscuring all things. Professor Forgue, in 1897, drew attention to a most important point, by suggesting that the patient should, in such circumstances, be placed in the semi-recumbent position at an angle of 45 degrees. The viscera fall away from the wound, and venous oozing is checked.

In some few instances the loss of substance caused by the blow of the bullet has been so great that when the wound is securely closed, a marked narrowing—in one case an obliteration at the pylorus—has been produced. It would be necessary, then, to perform gastro-enterostomy to afford an efficient outlet, or to use the rent at the pylorus for the purposes of a gastro-duodenostomy.

Closure of the perforation having been effected, the abdomen is cleansed by wiping or by lavage, and the abdominal wound is closed. Drainage may or may not be necessary. Forgue advises its unvaried adoption, for the reason that a bullet traversing the clothes and the abdominal wall is certain to carry infection with it. Karlinski performed experiments upon rabbits which were wrapped in garments made of military cloth. They were shot in the abdomen, and the abdomen opened and its contents subjected to the most minute examination. Fine fragments of cloth were found in the peritoneum. Drainage may be effected through the anterior incision or through posterior incisions specially made for the purpose.

SECTION III.

OPERATIONS UPON THE INTESTINES.

CHAPTER XX.

INTESTINAL LOCALISATION.

It would undoubtedly be a matter of great interest and importance to the surgeon to discover if there were any means of determining with accuracy the exact position in the intestine held by any selected loop. Much labour and patience have been expended upon this task, and though the results are not so satisfactory as could be wished, they have, nevertheless, afforded us some valuable information. It is to Mall ("Bulletin of the Johns Hopkins Hospital," 1898, vol. ix, p. 197) and to Monks (Trans. Amer. Surg. Assoc., 1903, p. 405) that we are indebted for the best work in this matter. There are certain inherent difficulties in the subject. The intestine, for example, may be of any length from fifteen to thirty feet; the position of all its parts is liable to some variation from time to time, owing to unequal filling, to the position of the individual, and so forth; and the changes which occur in the bowel itself and in the mesentery by which it is attached are not sharp and abrupt, but gradual throughout.

Mall, in his examination of the condition of the mesenteric loops in 41 bodies, found what he called a normal arrangement in 21 of them. The sweep of the mesentery, and therefore of the bowel which it attached, in this "normal" arrangement was as follows: first to the left, then upwards and to the right, then obliquely downwards and to the left iliac region, then into the pelvis, and finally up to the right in the ileocæcal region.

It is more than probable, however, that during health there is a constant journeying of the large and small intestine from one part of the abdomen to another, and that two loops of intestine which at one moment are in contact may, in a few seconds, be widely separated. This is shewn during operations for gun-shot wounds. Thus in a case of bullet wound where the shot traversed the abdomen directly from front to back, a little in front of the left anterior superior spine of the ilium, the jejunum in four places, the transverse colon in two places, and the lower end of the sigmoid were wounded.

Monks found that in normal conditions the upper six feet or so of the intestine were generally confined to the left hypochondriac region, occupying a deep fossa there, under the ribs, in such a position that its coils would not usually be encountered through any of the ordinary abdominal incisions. The middle portion usually occupied the middle part of the abdomen, while the lower part of the intestine lay generally in the pelvis and in the right iliac fossa. He writes:

"In order roughly to indicate on the outside of the body the positions ordinarily occupied by the upper, middle, and lower thirds of the intestine, I have found that two straight lines running obliquely across the abdomen at the two ends of and at right angles with the line of the mesenteric root will divide the abdomen into three regions, each of which will contain in most bodies about one-third of the intestinal tube, the upper third being in the first region, the middle third in the second region, and the lower (or third) third in the third region, as shewn in the diagrams.

"It will thus be seen that an incision anywhere above the first line will probably disclose loops belonging to (or near) the upper third of the intestine, anywhere between the first and second lines, loops belonging to the middle third, and anywhere below the second line, loops belonging to the lower third. This appears to be a pretty good general rule in intestinal topography, to assist us in determining, while making our incision, what part of the bowel we are likely to meet with first. We should not forget, however, that there are occasional and marked exceptions to this rule."

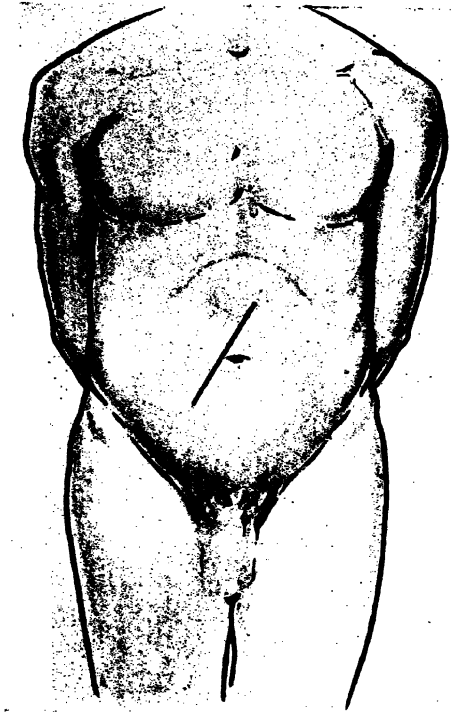


Fig. 111.—Shewing approximately the line of the mesenteric root as traced on the abdominal wall (Monks).

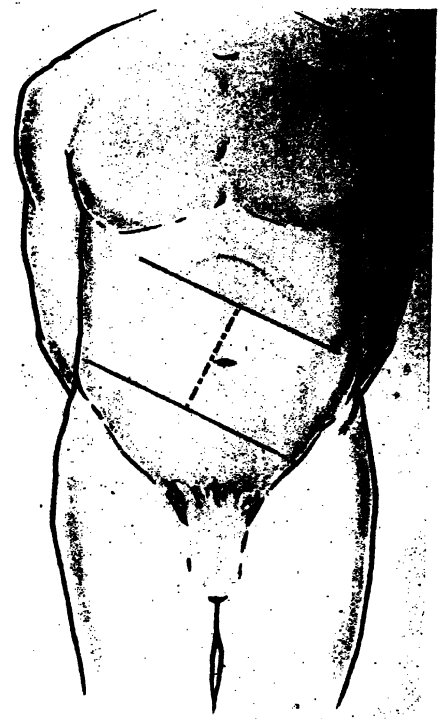


Fig. 112. — Shewing the two oblique lines (black) drawn at right angles to the two extremities of the line (dotted) of the mesenteric root. The upper, middle, and lower compartments here indicated contain in most cases the upper, middle, and lower thirds of the small intestine respectively (Monks).

When the small intestine is examined from end to end, it is found that it is funnel-shaped, and that the upper part of the jejunum is of greater diameter than the lower part of the ileum. This is, of course, well recognised clinically by the fact that the further a gall-stone travels down in the bowel the more likely it is to become impacted; that a stone which easily passes through the jejunum is arrested in the ileum. The diameter of the last three or four feet of the ileum shews little or no narrowing as a rule.

As the bowel narrows in this way its walls also become thinner. The upper part of the jejunum feels thick when rolled between the fingers, owing to the presence of large and numerous valvulæ conniventæ. The ileum is thin, and its walls are more supple. The last two feet, approximately, of the ileum again become thicker, and just above the ileocæcal valve the muscular tissue in the ileum shews a decided increase. The condition of the mesentery is exactly the opposite of this: the thinnest part is that which runs to the upper end of the jejunum; the thickest part is that which runs to the lower end of the ileum. The mesentery, therefore, becomes gradually thicker the lower down it lies. This increased thickness is largely due to the deposit of fat, at first in thin scattered islets, later in larger thick slabs between the leaves of the mesentery. The upper part of the mesentery is thin and translucent. Monks draws attention to a point of importance. He writes:

"If one raises a loop from the uppermost part of the intestine and holds it in such a position that the light will shine through the mesentery, one will notice, in that part of the mesentery close to the gut, little transparent spaces between the vasa recta. Some of these 'lunettes,' as I call them, are almost *always present opposite the upper part of the gut* even in the thickest mesenteries. I have found, as a rule, that they gradually grow smaller, become streaked with fat, and disappear at about the eighth foot. They may, however, in exceptional cases, persist to the end of the gut."

Some idea of the position occupied by any loop drawn out by chance through an abdominal incision may be determined by pulling upon it until its mesentery is taut. The finger is then passed along the upper, right, side of the mesentery until the posterior abdominal wall is reached. The relation of the point reached to the line of the attachment of the mesentery will then be recognised. In this way, moreover, by passing the fingers on both sides of the mesentery, its upper right side will be distinguished from its lower left side, and, therefore, the direction in which the bowel is running is determined.

The arrangement of the vessels in the mesentery has been studied by Dwight and Monks. Dr. Monks writes:

"Opposite the upper part of the bowel the mesenteric vessels are distinctly larger than opposite any other part of it. These vessels grow smaller and smaller as we pass downward until the lower third of the gut is reached, where they remain about the same size as far as the ileocæcal valve. The arrangement of the mesenteric vessels has some features which intimately concern the subject in hand, and which I shall describe with some detail. Diagrammatically speaking, the main branches of the superior mesenteric artery unite with each other by means of loops, which are called, for convenience, 'primary loops'; in some parts of the tube, 'secondary loops'; and even occasionally 'tertiary loops' are superimposed upon these. From these loops little straight vessels—the vasa recta already referred to—run to the bowel, upon which they ramify, alternating, as a rule, as to the side of the intestine which they supply. The mesenteric veins are arranged in a manner somewhat similar to the arteries. Opposite the upper part of the bowel there are only primary loops. Occasionally a secondary loop appears, but it is small and insignificant as compared with the primary loops, which are large and quite regular. As we proceed down the bowel secondary loops become more numerous, larger, and approach nearer to the bowel than the primary loops in the upper part. As a rule, secondary loops become a prominent feature at about the fourth foot. As we continue farther downward the secondary loops (and, possibly, tertiary loops) become still more numerous and the primary loops smaller, the loops all the

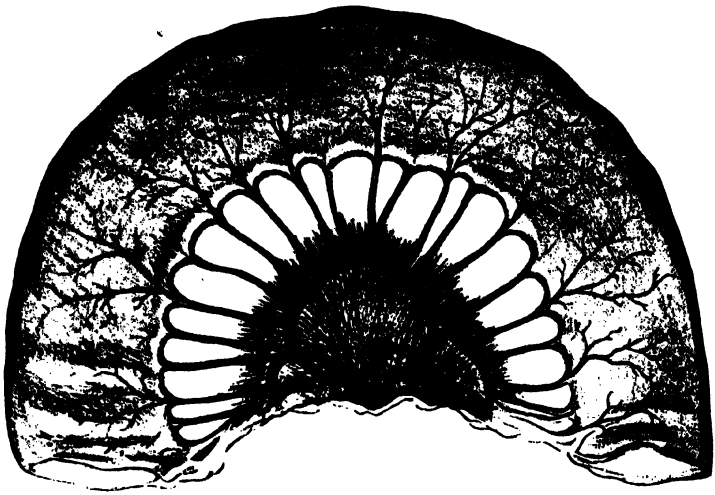


Fig. 113.—A loop of intestine, the middle of which is exactly three feet from the end of the duodenum. The gut is of large size. The mesenteric loops are primary, and the vasa recta large, long, and regular in distribution. The translucent spaces (lunettes) between the vessels are extensive. Below, the mesentery is streaked with fat. The veins, which had a distribution similar to the arteries, are for simplicity omitted from this and from the subsequent drawings. The subject from which the specimen was taken was a male of forty years, with rather less than the usual amount of fat. The entire length of the intestine was twenty-three feet (Monks).

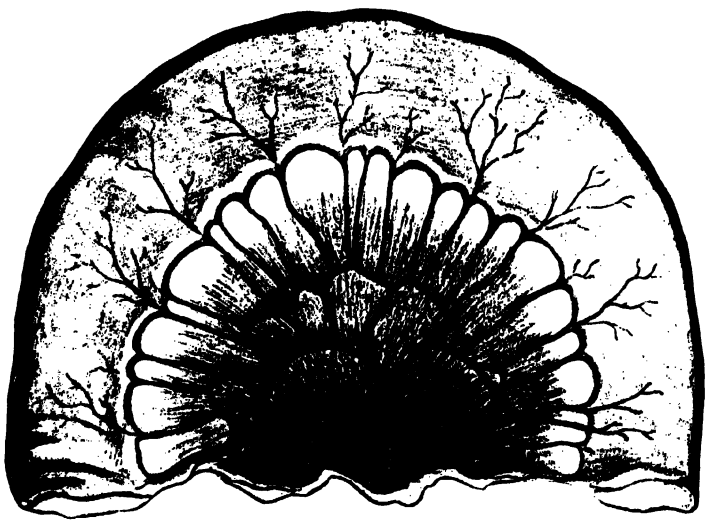


Fig. 114.—A loop of intestine at six feet. As compared with Fig. 113, the gut is somewhat smaller. The vascularity of the intestine and mesentery is less. Secondary loops are a prominent feature. The vasa recta are smaller. The lunettes are also present, but are not so large as in Fig. 113. The subject was a male of about thirty-five years, with an average amount of fat. The entire length of the intestine was twenty feet (Monks).

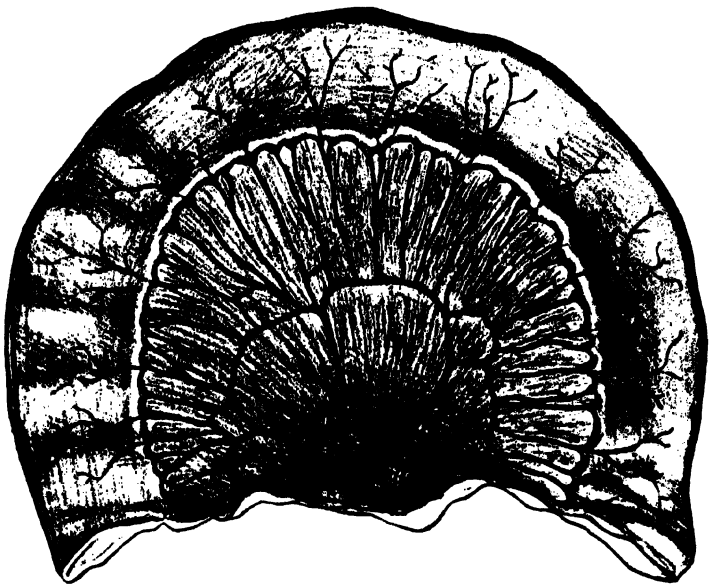


Fig. 115.—A loop of intestine at nine feet. The secondary loops are large; the vasa recta are somewhat irregular and shew branches. No lunettes are present, and the mesentery is streaked with fat, and is, therefore, somewhat opaque. The specimen was taken from the same subject which furnished Fig. 113 (Monks).

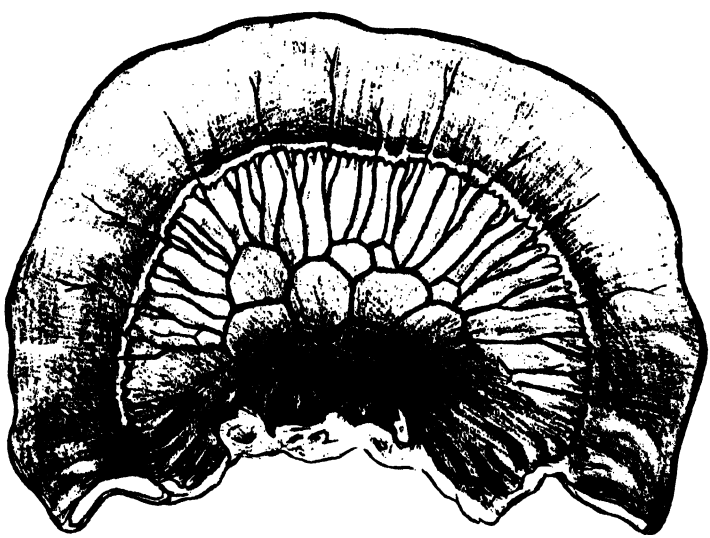


Fig. 116.—A loop of intestine at twelve feet. The vessels are smaller. The primary loops are lost in the fat, but secondary and even tertiary loops are visible. The vasa recta are shorter, more irregular, and branching. The specimen came from the same subject which furnished Figs. 113 and 115 (Monks).

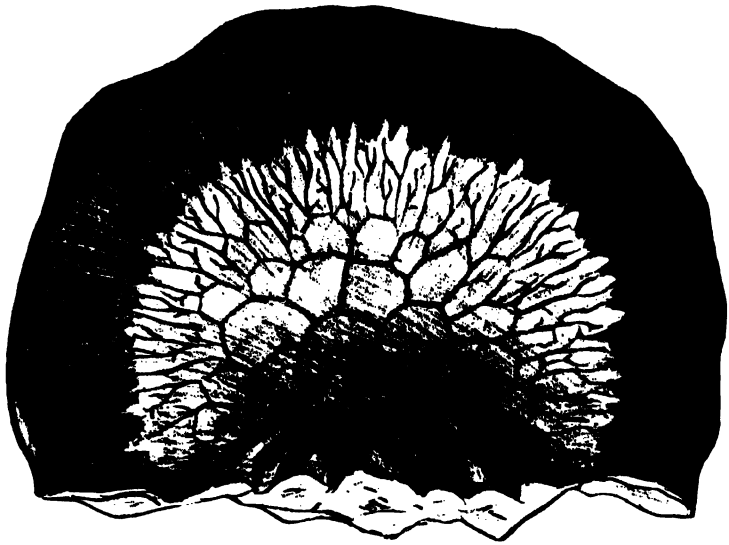


Fig. 117.—A loop of intestine at seventeen feet. The mesentery is opaque, and small tabs of fat begin to appear along the mesenteric border of the gut. The vessels are represented by a somewhat complicated network, and are seen with difficulty in the thick fat of the mesentery. The specimen came from the subject which furnished Figs. 113, 115, and 116 (Monks).

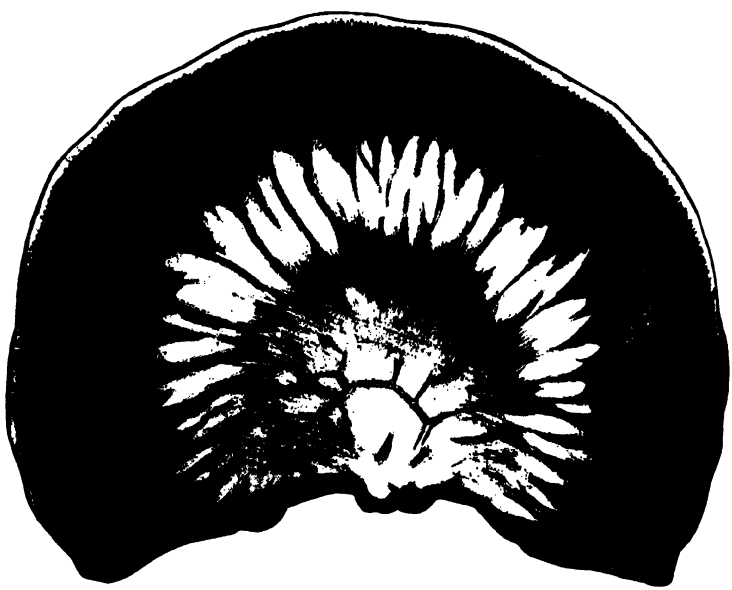


Fig. 118.—A loop of intestine at twenty feet. The gut appears to be thick and large. The mesentery is quite fat and opaque, and large and numerous fat tabs are present. The vessels, which are complicated, are seen with difficulty, and are represented by mere grooves in the fat. The subject was a stout woman, and the entire length of the gut was twenty-one feet (Monks).

time getting nearer and nearer to the gut. Opposite the lower part of the gut the loops generally lose their characteristic appearance, and are represented by a complicated network. Opposite the upper part of the intestine the vasa recta are from *three to five centimetres* long, when the loop of small intestine to which they run is lifted up so as to put them gently on the stretch. They are straight, large, and regular, and rarely give off branches in the mesentery. In the lower third *they are very* short, being generally *less than one centimetre* in length. Here they are less straight, smaller, less regular, and have frequent branches in the mesentery."*

* For the figures which are here reproduced I am very greatly indebted to the courtesy of Dr. G. H. Monks.

CHAPTER XXI.

INTESTINAL SUTURE.

THERE are probably no pages in the history of surgery that are so grossly encumbered with the description of useless methods of work as those dealing with the subject of the suture of intestinal wounds. Of the methods which have been advocated, volumes might be written, and willing and patient authors have not been found wanting. It is true that there has been a constant and laudable striving after perfection, but the steps upon the road to success have been infinite in number, and they have not all been steps in a forward direction. Even at the present time this subject is not free from the incursions of the eager inventor, enthusiastic as to the claims of his newest contrivance, despite the fact that all mechanical aids to suture are unnecessary —in that one word may be summarised all that can be said of them. I do not venture to suggest that even yet any method has been advocated that will win universal acceptance. But of this there can be no question, that such a method, when established, will of necessity combine in the highest degree two essential principles—simplicity and safety. A method that is simple, and therefore readily learnt, applicable to all forms of anastomosis, speedy because of its simplicity, and safe because of all its attributes, is the only one that is destined to survive.

The following suture methods possess certain definite advantages which have caused them to be practised by a large number of surgeons—they are recognised, that is, as good methods.

Lembert's Suture.—This, which is the simplest of all interrupted stitches, is one that every surgeon finds it necessary to use on some occasion. The needle, bearing a suture of fine silk or thread, is passed transversely to the wound. It picks up,

on each side, all the coats except the mucosa, and is introduced about a quarter of an inch, or rather less, from, and emerges about a line from, the edge of the wound, on one side, then passes across the wound, to enter on the opposite side at a point just clear of the cut edge, there to pass in the wall of the gut in the same manner as on the opposite side. When the suture is tied, the edges of the wound are inverted and broad surfaces of peritoneum on each side of the wound are brought into contact. The individual sutures lie about $\frac{1}{8}$ inch from each other. In tying the stitches it is important to avoid drawing them overtight, and thereby causing a risk of strangulation necrosis. A snug apposition of surface is all that is necessary to ensure a perfectly firm, water-tight junction. When this suture is continuous and not interrupted, it is known as Dupuytren's suture.

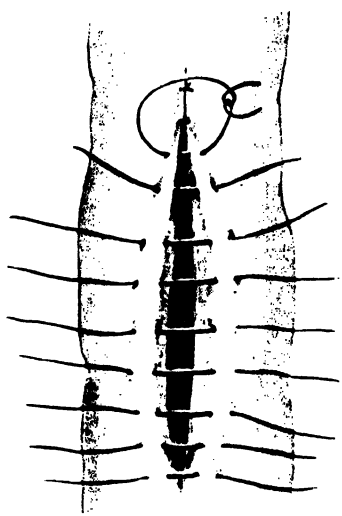


Fig. 119.—Lembert's suture.

The width of the fold picked up on each side will vary according to the necessities of the case. If the wound be small and the bowel-wall healthy, so that sutures are well held, the fold need be but small and the inner row of needle punctures may be quite close to the edge of the wound. In other instances, as, for example, in the perforation of a duodenal or typhoid ulcer, a wider fold must be made, and greater care must be exercised in the introduction of the needle, since, owing to the thickened and stiffened wall of the gut, the needle will perhaps cut through, or the stitch will fail to hold when tightened.

Halsted's suture, or the mattress suture, is in reality so devised that each separate suture is the equivalent of a double

Lembert suture. The needle having passed from one side of the wound to the other is made to return, so that the two ends of the suture lie upon the same side of the wound. When the stitch is tied, there is no risk of undue constriction of vessels, and the stitch is little likely to cut through. Broad peritoneal surfaces are brought into apposition. The importance of the inclusion within the suture of the submucosa was emphasised by Professor Halsted. It was claimed for this suture that it is so safe that a single row is all that is necessary; that the tissues are less constricted than they are by a Lembert's suture, and that the suture does not so readily tear out when submitted to tension.

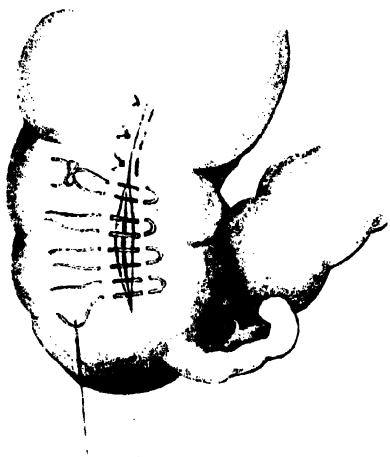


Fig. 120.—Halsted's suture.

Dupuytren's Suture.—This suture is similar to the Lembert suture, but is continuous, not interrupted. After the first suture

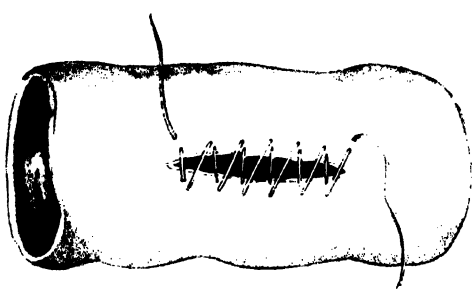


Fig. 121.—Dupuytren's continuous suture: a continuous Lembert's suture; it begins on the left.

is introduced it is tied, and the suture is then continued from side to side of the wound to the opposite end.

Cushing's Suture.—Hayward W. Cushing (Trans. Amer. Surg. Assoc., vol. xvii, 1899) has described a suture that is also continuous. The needle, on each occasion that it is introduced, is passed parallel to the edge of the wound, and not, as in the Lembert or Dupuytren suture, at right angles to it.

All the sutures above described are passed with the intention of including all coats of the bowel with the exception of the mucosa. The layer which it is of the chiefest importance to secure, in order that the suture may hold well, is the submucous coat. This, as shewn by S. D. Gross and Halsted, is of great strength and toughness, and will bear a considerable strain when the suture is tied.

The examination of specimens removed from patients upon



Fig. 122.—Cushing's right-angled continuous suture.

whom the Lembert suture has been used shews, without doubt, that the ideal passage of the suture is not always achieved. In not a few instances it is found that the suture at some point has passed into or through the mucosa. The fear that haunts the surgeon's mind is that if the suture should penetrate the mucosa, a track for the escape of infected contents from the lumen of the bowel is open to the peritoneal cavity. Theoretically the danger exists, but in practice it does not often prove serious, unless the perforation occurs at the point where a knot is tied, and then leakage is very likely to occur. In an interrupted suture, therefore, which perforates all the coats of the bowel, and in which the knot is tied on the serosa, there are the

elements of disaster. If, however, the interrupted suture is tied on the mucous side, it is found, as a matter of unvaried experience, that no leakage occurs, or rather that what drainage or "capillary attraction" is excited by the suture, is towards the lumen of the gut, and not towards the peritoneal cavity. It has been the aim, therefore, of many operators to devise a stitch which, passing through all the coats on both sides of the wound, may be tied in such manner that all the knots shall lie within the lumen of the gut. The advantages of such a stitch are obvious: a firm, accurate, and even hold is obtained upon the gut; the vessels in the cut edge of the gut are controlled when the stitch is made continuous, and a rapid introduction is easily accomplished.

The method which, among modern operations, was the pioneer of all those planning to effect union by through-and-through sutures, was suggested by Maunsell ("International Jour. of the Medical Sciences," vol. ciii, 1892, p. 245). The following is the description given by him:

"Having cut off the cancerous, gangrenous, or injured portion of the intestine, bring together both ends of the bowel with two temporary sutures passed through *all the coats* of the intestine. The long ends of these sutures are left intact. One is placed at the mesenteric attachment of the gut and the other (exactly opposite) at the most distant portion of the bowel from the mesentery.

"These temporary sutures are very important. They secure the complete peritoneal covering of the mesenteric attachment of both segments of the gut, help to maintain the proper relative position and accurate co-adaptation of the two cut ends, and facilitate their subsequent invagination through the opening made in the larger segment of gut.

"When enterectomy is performed for gangrene or injury, the lower or distal segment of the bowel is generally the largest; but where the operation is performed for stricture, cancer, or tumour pressing on or constricting the lumen of the gut, the upper or proximal portion is often much larger than the lower.

"If you examine the gut in a living animal, you will find

that the blood-vessels pass into it from the mesenteric attachment. These divide and subdivide until they are lost in an invisible anastomosis in that portion of the intestine more distant from the mesentery.

"I propose to make an opening here in the larger segment of the gut, through which the invaginated ends of the divided

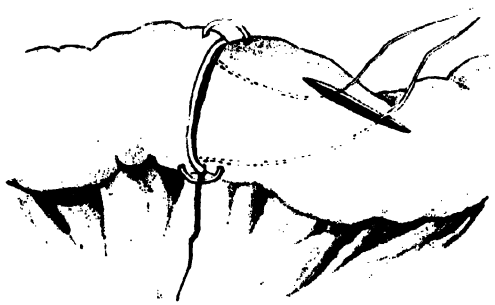


Fig. 123.—Maunsell's operation.

bowel may be dragged by the long ends of the temporary sutures, and when they are accurately sewn together all around, they may be pulled back into their normal position.



Fig. 124.—Maunsell's operation.

"The edges of the longitudinal slit made in the bowel, which begins about an inch from its transverse section, should be well turned in and brought together with a continuous suture passed through the peritoneal and muscular coats only. It is a well-ascertained fact that a slight longitudinal contraction of

the lumen of the bowel does not interfere with its physiological functions.

"By this simple device the perfect union by suture of a complete transverse section of the bowel, with its circumferential peritoneal surfaces in exact position and all the knots of the sutures on the inside, can be accomplished.

"From an examination of the annexed figures it may be seen that the peritoneal surfaces are in accurate juxtaposition all around. While an assistant holds the ends of the temporary sutures, the surgeon passes a long, fine, straight needle, armed with a stout horse-hair or very fine silkworm-gut through both sides of the bowel, taking a good grip (quarter of an inch) of all the coats. The suture is then hooked up from the centre of the invaginated gut, divided, and tied on both sides. *In this*



Fig. 125.—Maunsell's operation.

way twenty sutures can be placed rapidly in position with ten passages of the needle. The temporary sutures are now cut off short, and the sutured ends of the bowel painted with Wölfler's mixture of alcohol, glycerin, and colophony, and blown over with iodoform—the same that he applies to the surface of the raw stump after removal of the tongue. The bowel is then pulled back. The longitudinal slit in the gut is well turned in and closed with a continuous suture and painted with Wölfler's mixture and iodoform powder."

In actual practice, therefore, Maunsell was content to rely upon a single row of sutures penetrating all the coats of the bowel. Many surgeons, however, being sceptical as to the security from leakage with one layer of stitches only, added an outer layer of Lembert sutures. One of the further ob-

jections to Maunsell's method was the possible formation of a diaphragm if an outer layer of Lembert sutures was used. In their experimental work, Edmunds and Ballance found that no diaphragm whatever was formed. Maunsell, by his work, shewed conclusively that a perfect suture-line resulted from the use of a single layer of stitches passing through all the coats. His method, however, in that it involved the making of a special longitudinal opening into the gut, was found to be unnecessarily tedious and complex, and efforts were, therefore, directed to such a modification of the method as would permit the principle to be retained while the steps to attain it were simplified.

Dr. Gregory Connell and Dr. Wiggin have both succeeded in perfecting a simple and effective method. Connell's method is, it seems to me, one of the most satisfactory methods of suture in use at the present time. It is easy to learn, simple, rapidly performed, and the line of union is firm and free from any chance of leakage. The only difficulty that could possibly be experienced in its use is that which arises at the time of tying the final stitch. A very little practice makes this easy. The following description is given by Dr. Gregory Connell in "American Medicine," vol. v, January, 1903, p. 135. I am greatly indebted to him for the excellent illustrations he has kindly sent to me, which are here reproduced.

"In using the interrupted suture, the first stitch should be taken at the mesenteric attachment. This stitch is of the greatest importance on account of the separation of the serous covering of the bowel at this point, and great care should be exercised in securing a perfect serous approximation at this point. In order to do this in the most satisfactory manner a stitch should be introduced as follows: The needle is made to enter the bowel-wall of one cut end from the lumen, perforate all coats, and pass through the serosa of one side of the triangular space formed by the separation of the serous coats; then on, over and through the serosa of the opposite cut end, at the same relative point, side of the triangular space, then



Fig. 126.—Connell's suture.



Fig. 127.—Connell's suture continued.

on through the wall into the lumen. This completes one-half of the stitch, and is made with one movement of the needle.

"The needle is next reversed, and a distance of about $\frac{1}{8}$ of an inch (3 mm.) is made to repeat the steps in the opposite direction—*i. e.*, entering the mucosa of the second cut end, passing through all coats of the bowel-wall, including the serosa of the triangular space, and then through the serosa of the triangular space of the first cut end, on through the wall into its lumen, where the needle end and the free end of the suture



Fig. 128.—Connell's suture continued.

are tied in a knot on the mucosa. This stitch, which acts similar to a brad, absolutely secures a perfect serous approximation at this point, which is considered by all to be the most difficult portion of an enterorrhaphy.

"The remainder of the union is closed by stitches exactly similar to this first stitch. The cut ends are held in proper position by any convenient means, such as the Lee holder, the Allis tenaculum forceps, or suspending loops of thread; but the best method in my experience is the plan of introducing

a stitch, such as are the other stitches, at a conveniently distant point, and leaving the ends of this stitch long, to be held by an assistant while the intervening stitches are being inserted.

"This method has the advantage of consuming no additional time, for when the union is completed up to this stitch and the long ends are of no farther use, they are cut away, leaving the stitch itself in place. This method, which I described in 1901, has been adopted by Dr. Wiggin in the description of his method published in 1902.

"With the ends thus held in proper position the introduction of the stitches is a very simple matter—merely one passage of the needle through all coats of both cut ends, and then at a distance of about $\frac{1}{8}$ of an inch (3 mm.) the same process in the opposite direction, and, finally, the tying of the knot upon the mucosa at one side of the seam.

"This is repeated till all but a small portion of the union is completed. Owing to the fact that it is impossible to place this last portion of the cut ends in the same relative position that we placed the first part—*i. e.*, seroserous apposition, it is therefore necessary, in order to introduce the same variety of suture, to proceed somewhat differently.

"In order to place the last stitch and knot in exactly the same relative position as the first ones, we proceed in this manner:

"The needle enters the gut-wall from the lumen, passes through all coats, and emerges from the serosa of one side. It is then made to cross over to the opposite wound margin, and, entering the serosa, passes through all the coats into the lumen of this side. The needle is then turned upon itself and made to retrace its steps at about $\frac{1}{8}$ of an inch (3 mm.) distant, passing from the lumen through all coats, emerging from the serosa; then over to the opposite side and entering through the serosa, and finally ending in the lumen of the cut end at which it began.

"Now the two ends of the thread which are to make the knot are side by side, emerging from the mucosa into the lumen, and then extending from the ununited part of the enterorrhaphy out of the body. The needle, in introducing this stitch, has passed through the cut ends in exactly the same order as it did when inserting the stitches in the earlier part of the operation when the cut ends were held in seroserous apposition—*i. e.*, mucosa, sub-

mucosa, muscularis, and serosa, then immediately on into the other end cut through the serosa, muscularis, submucosa, and the mucosa, and then this order repeated in the opposite direction $\frac{1}{8}$ of an inch (3 mm.) away.

"The needle and the free end of the suture now hang side by side from the mucosa, and in order that they be tied in a firm knot, proceed as follows:

"At a point in the line of union, about opposite this last and still untied stitch, a threaded needle is inserted, eye first,



Fig. 129.—Connell's suture continued.

between two of the previously inserted and tied stitches. The needle is passed between the apposed serous surfaces into the lumen.

"By passing the needle still farther onward it is made to present at the location of the last stitch, where the ends of the suture still protrude, and where the surfaces are not united. By slightly withdrawing the threaded needle a loop is formed with its thread; into this loop are placed the two free ends of the last stitch which is to be tied. By withdrawing the needle

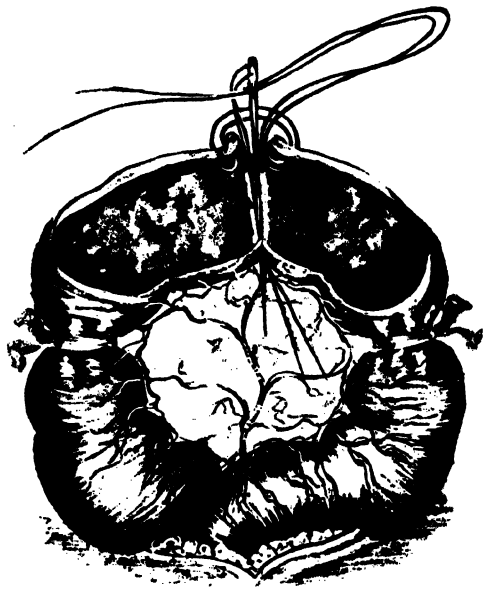


Fig. 130.—Connell's suture continued.



Fig. 131.—Connell's suture continued.

and in its loop the stitch ends, these ends will be made to present upon the peritoneal aspect of the bowel on the opposite side, between two of the previously inserted and tied stitches—*i. e.*, at the point where the threaded needle was inserted. Slight traction upon these ends will cause the remaining portion of the line of union to become inverted, and seroserous approximation will obtain entirely around the site of suture. Upon greater traction the bowel will become flattened, bringing the mucous membrane upon which the last knot is to be located into intimate relationship with the line of suture at the point where



Fig. 132.—Connell's suture continued.

the free ends protrude. The knot is tied with the bowel in this flattened position, thus avoiding the occurrence of any slack. While still retaining the tension and the flattened position, the ends of the knot are cut off short, so preventing any long free ends in the lumen. Upon allowing the bowel to assume its normal contour,—that of a cylinder,—the knot will slip between the already tied stitches into the lumen, and as it is attached to the mucosa of the opposite pole of the diameter of the gut, it goes with that portion of the bowel-wall."

The Connell stitch here described is, therefore, an interrupted stitch. In the same paper, however, Dr. Connell writes:

"As stated on previous occasions, either the interrupted or the continuous suture may be employed, the choice depending upon the teaching or the experience that the operator has had. This method may be applied equally well in circular enterorrhaphy, lateral anastomosis, pylorectomy, pyloroplasty, gastro-enterostomy, and in incised wounds of the intestine or stomach,—in fact, under any conditions where the ordinary sutures may be employed."



Fig. 133.—Connell's suture continued.

Though interrupted sutures are, in certain stages of work, absolutely indispensable,—for example, in reinforcing at a weak spot or in securing a vessel in a cut edge of the gut,—yet I am convinced that the continuous suture is very decidedly to be preferred. The continuous suture is easily and rapidly introduced—very much more rapidly than the interrupted stitch. In the latter, the needle has to be received from an assistant, to be passed, the knot to be tied, and the ends to be cut for each separate stitch; such a series of separate movements necessarily involves a waste of time. The continuous

suture is tightened to exactly the right degree without any difficulty. It acts, when embracing all the coats, as a hæmostatic, making the separate ligation of bleeding points unnecessary. It produces, when used as a Dupuytren's suture, very accurate and equal apposition of serous surfaces along the entire length of the wound. It has never, in my hands, caused sloughing of the cut edges of the wound from constriction of the blood-supply, and I am, therefore, compelled to think that this fear, so often expressed, is but a legacy from an earlier age. The objections which have been raised to the continuous suture are—

(*a*) If one part of it becomes loose, the whole is liable to become insecure. When properly introduced, in the manner to be presently described, there is no fear whatever of any part of the suture working loose, nor, on the other hand, of any part of the suture causing puckering by being drawn overtight. An even tension all along the line is secured by unconscious effort after a little practice.

(*b*) If the bowel contract, the whole suture may become loosened and the wound gape. This might perhaps be true of a continuous serous stitch unsupported, but if a firm hold of all the coats is obtained, the fear of loosening is purely visionary.

(*c*) A considerable length of ligature material is left in the coats of the intestine. It has been shewn, as the result of experimental work and of observation upon man, that a stitch which perforates the mucosa will by degrees become loosened, and eventually pass entirely into the lumen of the gut. A stitch including the serous and muscular coats only will remain imbedded in the coats of the gut for months or years, but may also, probably because of a too deep penetration of the wall, eventually be discharged into the lumen. This, I believe, occurs in the very great majority of instances. On several occasions I have had the opportunity of examining an intestinal or gastro-intestinal anastomosis many months after the operation, and I have, in almost all, found that no trace of the original suture of silk or thread remained. The objection to the length of the suture cannot be upheld.

These supposed disadvantages of the continuous suture have no foundation in experience. It is true that the continuous suture can cause harm if improperly applied, but the same objection holds good to all forms of suture, and, indeed, to all surgical methods. The vice then is not in the suture, but in the wrongful application of it. It is perfectly easy to learn exactly how to introduce the stitch and the degree of tension that is the safest.

Of all methods of intestinal suture, it would seem to me that one is unquestionably the best for general use. It is the method in which two sutures, both continuous, are used. The inner suture includes all the coats, the outer, the serous, muscular, and subserous coats only. The inner stitch secures good and efficient approximation, a firm apposition, in fact, and acts perfectly in controlling the bleeding from the cut edge of the gut. The outer suture supports the inner and ensures a sufficient apposition of serous surfaces.

It might be feared that such a stitch would cause an inversion of the suture-line to a degree sufficient to give rise to a spur or diaphragm. In practice, however, it is found that the fear is not justified. The little thickening at the suture-line, though plainly seen within the first few days, gradually dwindles until a normal appearance remains.

This method of suture is applicable to all forms of intestinal anastomosis. I have used it in gastro-enterostomy, after intestinal resection in the small and large intestines, and after excision of the cæcum, both for lateral and for end-to-end anastomoses. Its universal applicability is, of course, greatly in its favour, for a surgeon can the more speedily complete a suture to which he is accustomed. It is simple and safe. I have used it in one part or another over 500 times, and the only occasion upon which the suture-line has leaked was in a case of end-to-end ileocolostomy, where a small fæcal fistula formed and remained open for about ten days. When the suture is completed, the accu-

rate apposition ensured by the inner suture prevents leakage until such time as a perfect serous union is completed.

The suture is applied in the following manner: The two openings, whether terminal or lateral, that are to be united are placed



Fig. 134. — Intestinal suture for end-to-end or lateral anastomosis. The cut ends are clamped and the outer seromuscular suture is commenced.

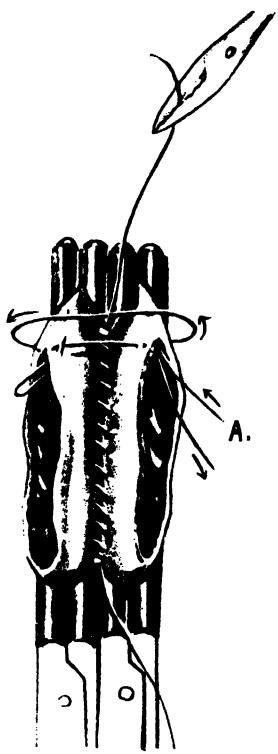


Fig. 135.—The seromuscular suture in its first portion is completed. The inner suture which embraces all the coats is begun. Note especially the manner in which the gap in the mesentery is secured. The needle enters at the point, A, and passes at the direction of the arrow.

side by side, the bowel in which they are, being held by a clamp. The outer or serous stitch is now commenced at the part of the gut farthest from the operator, and an ordinary Dupuytren's stitch is used, being continued around the posterior margin of the opening until the point nearest the operator is reached, when the

needle is laid aside. The needle, on each occasion that it is passed, picks up only the serous and muscular and in part the submucous coats. At least that is the intention of the operator, but I think it not at all unlikely that sometimes the needle may penetrate deeper than this, and include all the coats of the bowel. If this is done no harm comes from it.

The second inner stitch is now started. The needle is passed through all the walls of the gut, which lies to the operator's right, at the point of the bowel which is farthest from him. After passing from the mucous to the serous coat, it is withdrawn and then passed through the opposing gut from the serous surface to the mucous, and the suture is tied, so that this knot lies within the lumen of the bowel. If an end-to-end anastomosis is being performed, the first stitch is taken in the manner shewn in the annexed drawing. The end of the suture is left long and is held by a clip. The stitch is now passed along the hinder margins of the openings to be united, until the part of the gut nearest to the operator is reached. Half of the suture line is then completed. The suture now returns to the point from which it started along the anterior margin, picking up all the coats in the same manner until the original end of the suture is reached, when the stitch is knotted and cut short. If it is desired to infold the mucous membrane, which is better though not necessary, the anterior layer of this inner suture is passed in a different manner. The principle

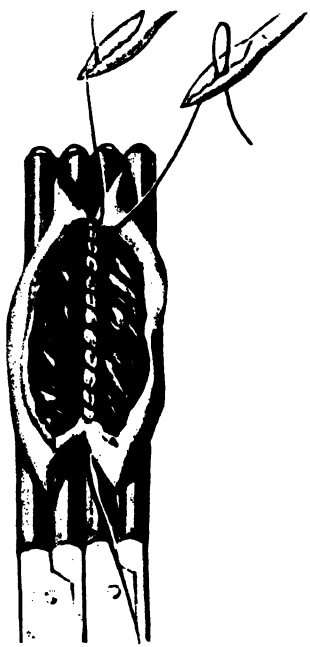


Fig. 136.—The first portion of th inner suture is almost complete This is the point at which the char acter of the stitch changes, as shewn in next illustration.

to be then observed is to pass the needle twice consecutively through each side of the wound so as always to leave a loop on the mucous surface. On each wound edge the needle then passes

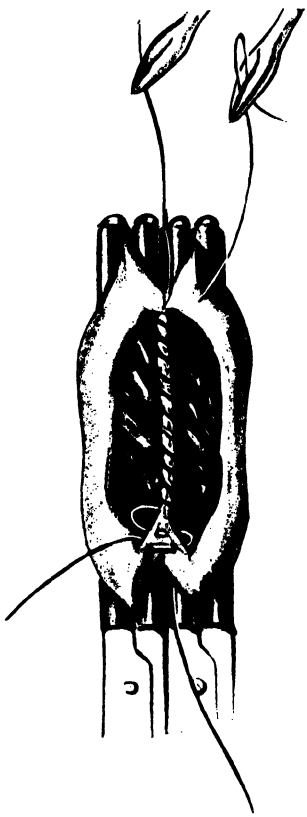


Fig. 137.—The inner through-and-through suture is changed here. The needle having reached the mucous surface of the left opening is passed in on this side again from mucous to serous surface. Then on the right side it passes from serous to mucous and back from mucous to serous surfaces, so that a loop is always left on the mucosa.

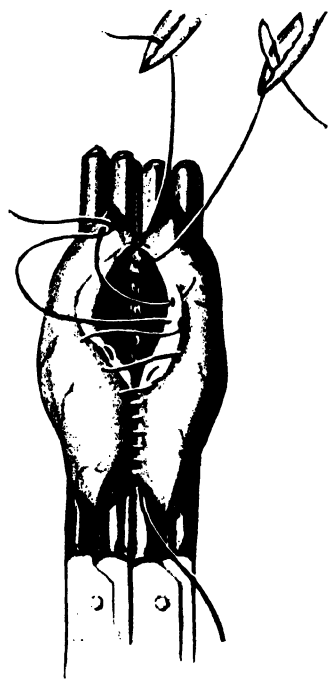


Fig. 138.—The inner suture continued. Note the loops always on the mucosa. When the stitch is tightened the cut edge of the mucosa is infolded and serous apposition secured.

from serous to mucous, and at once back from mucous to serous surface. As the stitch is drawn tight the mucosa becomes infolded. The character of the suture stitch, from the ordinary

continuous running stitch to the "mucosa-loop" stitch, is changed when the first half of it is almost complete at the point shewn in the figure. The needle is introduced at points about $\frac{1}{10}$ or $\frac{1}{12}$ of an inch apart, and the stitch is tightened to the necessary degree by holding it taut for the better demonstration of the next point for the introduction of the needle. When this stitch is complete, the clamps are generally removed. The outer serous stitch is now continued; the needle which was temporarily laid aside being again picked up and the suture continued around the anterior margin of the first suture until the point is reached from which it started, when the suture is tied and cut short. The needle which it will be found most convenient to use is the ordinary curved intestinal needle; for suture material I prefer celluloid thread. The stitch is not interrupted or knotted at any point.

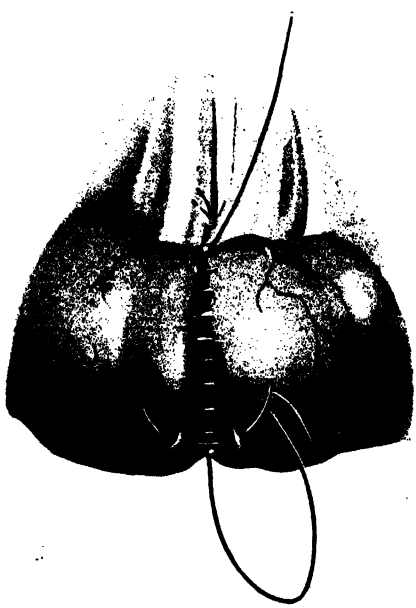


Fig. 139.—The inner suture completed; the return half of the outer suture begun.

Such are the chief forms of intestinal suture, and by the help of these all forms of intestinal repair or anastomosis can be safely accomplished. Of them all, I believe that the Connell stitch and the stitch just described, in which two layers of sutures are used, are those which possess undoubted advantages over all others. They are, in my opinion, the two sutures upon which surgeons of the present and of the immediate future will find it safest to depend. The use of mechanical appliances is no longer necessary; these have played their part—a most important part, I gratefully admit—in the development of surgical work, and it is

now time that their use should be abandoned. They have been useful, nay, indispensable, steps on the march of progress. To Murphy, above all other surgeons,—for his instrument is one of the most ingenious mechanical contrivances ever invented,—we should gratefully acknowledge the debt we owe. Without the knowledge that work with his button has given to us the surgery of the stomach and intestines would never have reached its present stage.

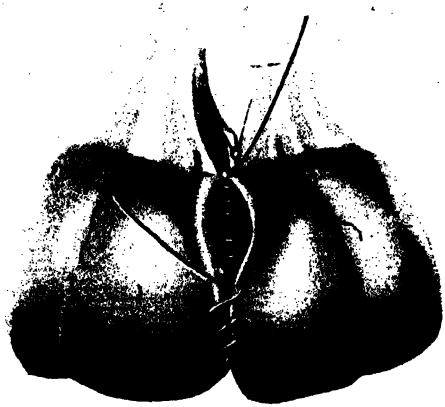


Fig. 140.—The inner suture completed; the outer one (seromuscular) resumed.

The weightiest argument against all mechanical aids to anastomosis is this—they are unnecessary. By their aid we do not accomplish anything that cannot be accomplished with equal rapidity and with greater safety by the simple suture. We have nothing to gain from their use, and we risk much by leaving behind something which may be, and often has been, the direct cause of danger and of death. The day of mechanical aids is over. The buttons and the bobbins, the elastic ligatures and the forceps of many forms, have now no more than an historical interest.

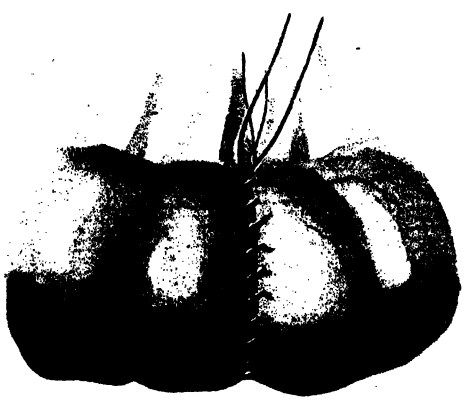


Fig. 141.—The two sutures complete; the final knot ready for tying.

CHAPTER XXII.

ENTEROTOMY AND ENTEROSTOMY.

ENTEROTOMY.

By the term enterotomy is understood the opening of the intestine for the purpose of immediate drainage or for exploration, followed by the closure of the wound. Enterotomy is to be distinguished from enterostomy, in which the opening in the intestine is fixed to the abdominal wall in such manner as to ensure continuous drainage from the bowel.

The operation of enterotomy is most frequently practised in cases of acute intestinal obstruction. It is also, though rarely, necessary, in cases of polypus of the intestine, or for the removal of a foreign body, such as a gall-stone. Enterotomy should be looked upon as an almost essential feature in cases of acute intestinal obstruction. If the distension of the intestine above the obstruction is considerable or of comparatively long standing, the needed relief to the patient is not afforded by the mere act of freeing the constricted spot. The mechanical impediment to the onward flow of intestinal contents is not the cause of the serious condition of the patient. It is the overloading, distension, and the ulceration of the gut above the block, together with the absorption of contents whose bacterial virulence is greatly increased, which call for instant relief. No operation for acute obstruction can be considered complete which leaves an intestine, whose function it is to absorb, overdistended by contents of an offensive and poisonous nature. To empty the bowel of its fæculent contents is not to add a danger to the operation by reason of the opening and subsequent suture, but to remove, at the expense of a trifling expenditure of time, that condition which makes most speedily for failure.

In a case of acute obstruction the operation is performed in the following manner:

The abdomen is opened, the point of ensnaring located, and the gut made free. The details of this procedure will be subsequently considered. The bowel which had been constricted is brought up to the surface and examined. A point about ten inches above the site of the constriction is chosen for the incision. It is desirable not to select a point nearer than this, because of the probable damage to the bowel within the few inches immediately above the obstruction. A loop, having been drawn out of the abdomen, is temporarily emptied and clamped by the fingers of an assistant. A longitudinal incision about one inch in length is then made in the bowel at the part most distant from the mesentery. The edges of this incision are seized and

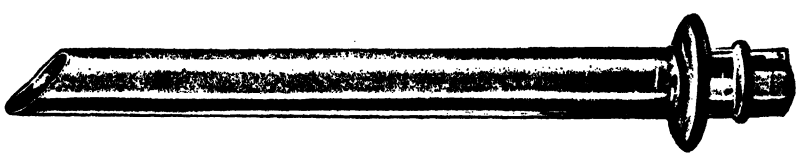


Fig. 142.—The author's tube for use in intestinal obstruction.

gently held with the finest French vulsella. The lower portion of the distended bowel—that between the site of the obstruction and the incision—is now emptied. Two fingers are placed one on each side of the intestine, and the contents are "milked" upwards and emptied through the incision, the lips of which are held apart by the vulsella. A glass tube (a Bantock's tube does very well) about six to eight inches in length, to the outer end of which a large drainage-tube is attached, is now gently introduced into the opening in the gut and pushed gradually upwards for three or four inches. The vulsella are now removed from the edges of the incision, and with a piece of gauze the bowel is drawn on the glass tube to within about an inch of the end to which the rubber tube is attached. At this point the bowel is held firm by an assistant, who wraps a piece of gauze, wrung out of hot sterile salt solution, around the tube and gut together.

Leakage by the side of the tube is in this way avoided. The surgeon now draws more and more of the intestine on to the tube, and as this is done, the bowel so drawn down empties its offensive contents through the rubber tube into a receptacle held for the purpose. It will be found that upon a tube 6 inches in length eight or ten feet of intestine can readily be drawn. This manœuvre must be carried out slowly and with great care. Time must be allowed for the perfect emptying of the bowel, and any damage to the bowel by the tube must be diligently avoided. When as much of the bowel as possible has been drawn on to the tube, the tube may be gradually withdrawn as the bowel, now



Fig. 143.—The bowel being pushed gently along the tube.

collapsed, is replaced gently within the abdomen, or, if thought desirable, the bowel may be washed out with warm sterile salt solution. This is done by puncturing the bowel at the highest point reached with a medium-sized needle to which a long India-rubber tube and a funnel are affixed. As the salt solution runs into the bowel it gradually trickles downwards and escapes by the rubber tube. The glass tube is withdrawn slowly, and the fluid is "milked" downwards towards its outlet. If the fluid is found to be running upwards in the intestine instead of downwards, the part of the gut immediately above the point of entrance of the needle is lightly closed with a Doyen's clamp.

When the glass tube is almost withdrawn, the flow of saline solution is stopped. If necessary, one or two ounces of Epsom salts dissolved in water may be introduced through the needle and allowed to remain. The needle is now withdrawn, and the point of puncture closed by a few Lembert sutures which fold the intestinal wall transversely. The bowel is now replaced, with the exception of the loop in which the incision for the tube was made. This is carefully washed after the removal of the tube, and closed by a double line of sutures—one including all the coats, the outer

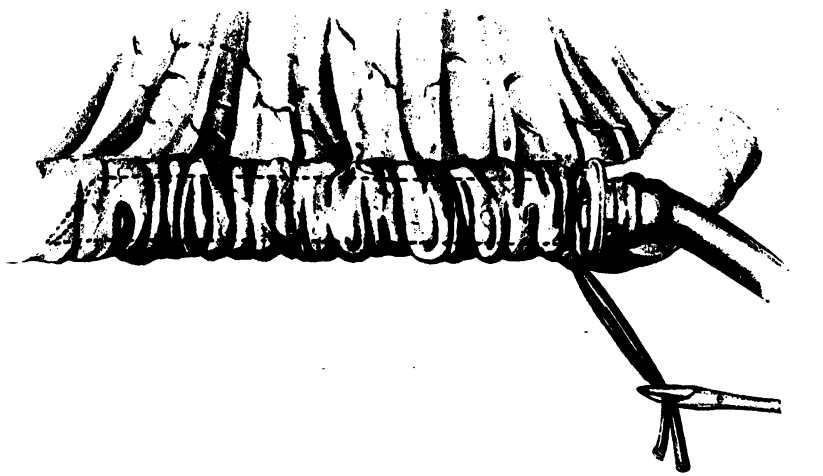


Fig. 144.—To shew the position of the tube when as much of the tube as possible has been drained by it.

picking up the serous and muscular coats only. Great care is expended upon these sutures, since they are being introduced into a gut already damaged by overdistension and perhaps by ulceration. A final cleansing of the loop is now made, and the whole bowel is replaced and the wound closed. If the bowel has suffered excessive damage from overlong distension, a point higher than ten inches from the constriction may be selected. On this, the operator must decide. It is essential to select a spot whose appearance and consistence are as little different from the normal as possible.

ENTEROSTOMY.

The operation of enterostomy consists in the fixing of the bowel to the abdominal wall and the opening of the bowel for the purpose of allowing an escape of its contents. Two forms of opening are made. In the one, the small intestine or the cæcum, as a rule, is opened for the purpose of temporary drainage, a *fæcal fistula* being made. In the other, the large intestine, as a rule, is opened for the purpose of permanent drainage, an *artificial anus* being made.

Temporary drainage of the intestine is generally adopted when, in cases of acute intestinal obstruction, the patient is in such peril that only the smallest possible interference can be tolerated. In circumstances such as these any search, however brief, however skilfully performed, would add a considerable danger to the operation. The purpose of the surgeon is then to give relief to the obstruction in the simplest manner, as speedily as possible, with the least possible disturbance of parts, leaving everything but the overloading of the intestine to be accomplished later. In some cases of obstruction, as Nélaton long ago pointed out, a mere relief from overdistension will permit a return to the normal. But such a fortunate event is of the greatest rarity, and it should, therefore, not be urged as a measure of persuasion to do an imperfect operation except in times of the greatest stress.

Enterostomy may also be performed at times with conspicuous success in cases of post-operative paralytic distension of the intestines where the patient is hastening to his end.

The operation of enterostomy, the formation of a fæcal fistula in the small intestine, is performed as follows: The skin being anæsthetised (a general anæsthetic is not necessary), the abdomen is opened by an incision about 2½ inches in length in the right iliac region. This position of the incision is that originally advocated in 1840 by Nélaton, and it possesses many advantages. The first and chiefest is that if the cæcum be dis-

tended, it can be opened,—typhlotomy,—but if it be collapsed, a point in the ileum low down is likely, as shewn by Monks and others, to present itself in the wound. The advantage of having the opening in the bowel as low down as possible needs no emphasis. As soon as the abdomen is opened the cæcum or a distended coil of the bowel is seized and drawn gently outwards. The position and direction of the loop of gut selected should be changed as little as possible. The bowel is now

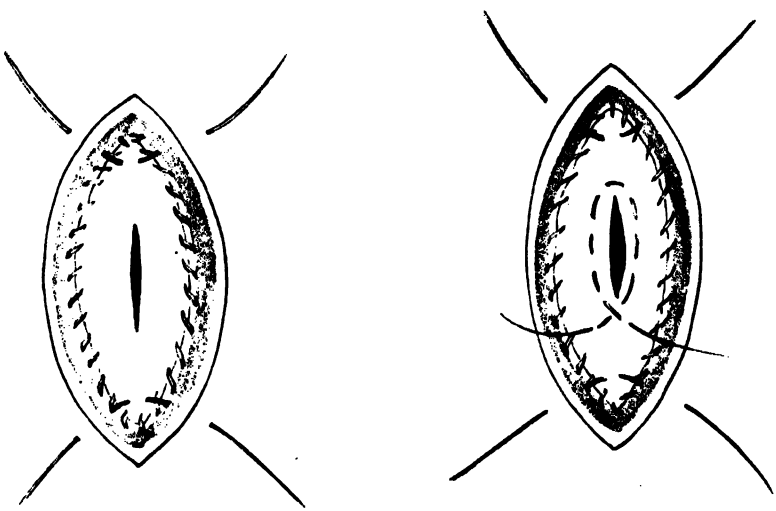


Fig. 145.—Enterostomy. Fæcal fistula—for drainage of intestine. The purse-string suture is tightened around a tube.

fixed to the parietal wound. Two sutures, one at each end, are first introduced. They pass through all the layers of the abdominal wound on one side, then pick up a broad piece of the serous and muscular coats of the intestine, and then pierce the opposite edge of the wound, passing through all the layers. These two sutures, one at each extremity of the portion of bowel to be fixed into the wound, secure a good attachment. They are left loose until a later stage. The peritoneal edges are now seized with two pairs of clips on each side, and a continuous

suture of fine Pagenstecher thread is introduced to unite the serous covering of the bowel to the parietal peritoneum and the muscle (or aponeurosis in the middle line) superficial to it. If the needle pass only through the peritoneum, it may tear, and a firmer hold is therefore desirable. It is most important, though sometimes difficult, to avoid a penetration of all the coats of the bowel when passing this suture. The skin should never be included. When this suture is completed, the through-and-through sutures are tied. The gut is now ready to be opened, but it is desirable to postpone the opening, if it can be done with safety, for a few hours. A delay of even a couple of hours will ensure a fairly accurate sealing-off from the peritoneal cavity. From the inflamed peritoneum, lymph is rapidly poured out. When the bowel is opened, it is desirable to have some apparatus at hand wherewith to carry off the profuse discharge. A Paul's tube to the outer end of which a large drainage-tube is attached is the most efficient of all. One of medium size will be found adequate. A somewhat similar tube, used in America, is known as "Mixter's" tube. Before opening the bowel a purse-string suture is applied around the spot at which the opening is to be made. When the tube is introduced, this suture is tied around the tube, and for the time prevents leakage. After two to five days, the suture works loose and the tube will be found to slip out. A second suture

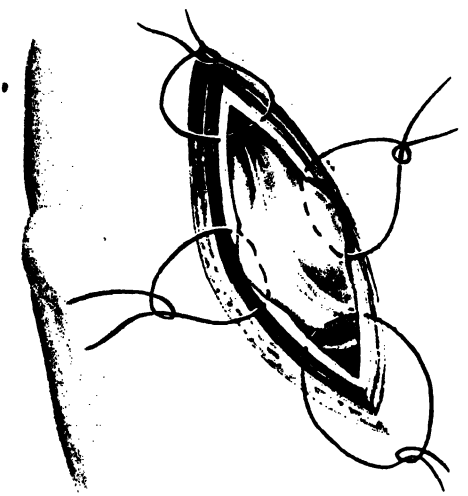


Fig. 146.—Typhlotomy. The chief sutures in position.

can then be applied, which will act for a couple of days longer, and will thereby postpone the soiling and irritation of the surrounding skin. Around the tube sterile gauze is packed so as to keep it fairly steady, and this is changed from time to time as seems necessary. When the tube has finally worked loose and has been removed, the intestinal contents are discharged on to the surface. As a rule, it is not long before the skin shews signs of redness and excoriation, and finally an intensely red, angry-looking, eczematous condition results. If the opening be anywhere in the small intestine, the condition of the patient is lamentable and an early closure of the fistula is desirable. As each peristaltic wave reaches the opening there is a spurt of fæcal material or of intestinal juice, and the patient experiences a fresh accession of burning, almost intolerable pain. His condition, to say the truth, is one of abject misery. The only relief to be obtained in such circumstances is afforded by keeping the patient once or twice a day in a warm bath for an hour. The skin irritation can be to some extent prevented by a frequent cleansing and by painting over the skin a saturated solution of pure rubber in benzine. This should be applied from the first, and a protective coating thereby given to the abdominal wall. Despite all care, however, the soreness of the skin will almost inevitably occur.

It is, as I have said, important that the continuous suture fixing the gut should not include the skin. The fistula is the more likely to close spontaneously if the skin is not included. The gut is, in fact, stitched to the abdominal wall in much the same manner as the gall-bladder in the operation of cholecystotomy, and in these cases, as in those, the fistula will shew a tendency to close. Closure of the gall-bladder is, however, a matter of certainty; closure of a fæcal fistula, performed in the manner described, is possible, though not frequent. In many instances the fistula has to be closed by operation in a manner to be presently described.

It is a matter of great importance that the opening should

be made into the intestine as low down as possible. The reasons for this are many. The high opening of the gut involves the risk of starvation. In those instances where the jejunum has been opened a speedy loss of weight follows, as might be anticipated. It is possible, in some such cases, to feed the patient by the fistula and so keep him alive or improve his condition, but an early closure of the fistula is, as a rule, imperative.

If the opening is made even three or four feet away from the cæcum, the bowel below the opening shews, as was pointed out by Lennander, the most remarkable tendency to contract adhesions. At a secondary operation for the closure of the fistula the separation of these intricate adhesions may be extremely difficult, and when the channel has been made complete, an intestinal obstruction may be caused by them. In one such case of my own a third operation had to be performed, and the gut at the site of the fæcal fistula joined, by lateral anastomosis, to the transverse colon. For these reasons, then,—the impossibility of recognising with the limited incision and with the necessary absence of handling the exact portion of the intestine which is seized, and the tendency to the formation of intricate and inseparable adhesions in the collapsed intestine below the fistula,—it is desirable to select for the opening, whenever possible, the cæcum rather than the small intestine. It is said that subsequent closure of a cæcal fistula is more difficult than in the case of an intestinal fistula. This has certainly not been my own experience; for in those cases of growth in the large intestine in which obstruction has been acute, the fæcal fistula has acted well, and when a later resection and end-to-end union of the colon have rendered the channel once more pervious, the fistula has often closed spontaneously or become materially reduced in size, so that an operation for its closure was of the simplest character. If the cæcum is found collapsed, the intestine must, of course, be opened, but, speaking generally, the opening of the cæcum is to be preferred to enterostomy.

In some cases the appendix may be brought up to the surface, fixed to the parietal peritoneum, and opened by cutting away the last half inch. A catheter may then be passed along the lumen of the appendix, and the cæcum can thereby be drained. When it is desired to close the opening, the wound can be reopened and the appendix be removed. This operation, first sug-

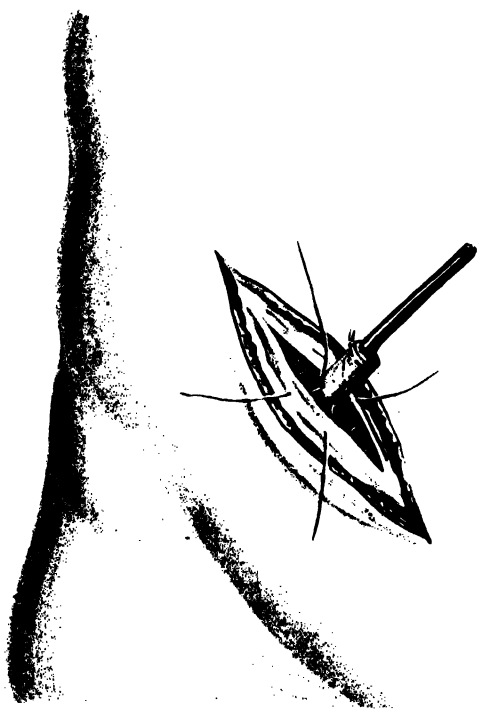


Fig. 147.—Appendicostomy. The incision in the skin is made long to shew the details of the operation. It need not be longer than 1 to 1½ inches when the operation is performed during life.

gested by Weir, of New York, is known as Appendicostomy ("Medical Record," August 9, 1902).

The operation of enterostomy, then, in certain cases, is undoubtedly a life-saving measure. In cases of advanced intestinal obstruction, when the bowel is overdistended and the patient's condition is bad, and in cases of so-called paralytic distension as-

sociated with septic peritonitis, due more often to appendicitis, a patient's life may undoubtedly be saved. But it is only for such exceptional cases that the operation should be reserved. It is true, as Nélaton claimed, that in a certain proportion of cases relief to the overdistension of the gut permits a readjustment of an entangled and obstructed gut, so that the normal condition is regained. Such an occurrence is, however, of the rarest and should never be expected. It is far more likely that even after relief to the overdistension the mechanical conditions of obstruction will persist and will lead to serious disaster. An ensnared loop will, for example, go on to gangrene, or perforation and extravasation will occur. Though recovery is possible, disaster is not improbably impending. The opening of the gut must, therefore, be considered only as a temporary expedient—to be avoided, if possible; to be resorted to only under the pressure of urgent necessity.

CHAPTER XXIII.

COLOTOMY.

The discussions as to the advantages of inguinal over lumbar colotomy, or vice versâ, lose much of their interest and importance if two points be conceded by the advocates of both operations. These two points are:

1. That in all cases, wherever the incision may lie, the peritoneal cavity should be opened.

2. That in cases of acute obstruction demanding colotomy the old methods should be abandoned, and a Paul's tube be at once introduced into the bowel above the block.

The necessity for the observance of the first point will be generally admitted. With modern methods the opening of the peritoneal cavity for such a brief period as is needed for the performance of an inguinal colotomy is quite devoid of risk. The chief point in the former advocacy of lumbar colotomy depended upon the fact that the operation could be performed without opening the peritoneum, and, in days gone by, this statement carried great weight. The extraperitoneal operation, however, is most unsatisfactory, for when the colon is brought to the surface and opened on that side which is bare of peritoneum, a comparatively small opening is made, the opening shews a constant tendency to become narrowed, and, as there is no "spur" at the opening, there is an unhindered passage of fæces down towards the rectum. The lodgment of fæces, constantly increased in quantity, in the parts near the growth, teases the patient in many cases far more than all his other discomforts. Moreover, the necessity for an extraperitoneal opening being made belonged to an age of ruder surgery.

So far as the second point is concerned, it is only necessary to say that it is by the use of a Paul's tube, and by that only,

that it is possible for the bowel brought to the surface to be opened at once without risk of soiling the peritoneum. The old extraperitoneal lumbar colotomy derived its chief claim to consideration from the fact that the bowel could be opened instantly without any chance of peritonitis ensuing. In any form of colotomy, however, the peritoneum may now be freely opened and its soiling be securely prevented by the use of a Paul's tube. This subject is considered further in the articles dealing with enterostomy and with the treatment of intestinal obstruction due to growth in the large intestine.

For all these reasons the conclusion is reached that an intraperitoneal operation is always desirable. The only question, therefore, to be decided is as to whether an opening in the loin is a matter of greater convenience to the patient than one in the inguinal region. For many reasons, which will be readily understood, an opening at the side is less revolting than one on the anterior surface of the abdomen—it is out of the way, so to speak. But being so, it is more difficult to attend to if the patient has to rely upon himself for his toilet. An opening in front is readily cleansed and the dressings are easily changed.

From the anterior opening there is, as a rule, a greater tendency to prolapse of the bowel than from a lateral opening. But when the method to be presently described is adopted, the likelihood of prolapse to an extent causing discomfort is negligible.

Much has been written about the distress and misery caused to a patient by the existence of a colotomy opening. I believe that this is largely, if not solely, due to improper methods in the performance of the operation; to the extraperitoneal operation, with its absence of spur and consequent dribbling of fæces into the rectum; and to the prolapse from an inguinal opening. I do not find that, with the method to be described, there is any discomfort or distress whatever after the first two months—after the time, that is, that the patient has acquired

some control over the opening. I have recently written to eleven patients upon whom I performed colotomy followed by proctectomy at various times, all over six months ago. Ten of the patients expressed themselves as perfectly content, and all told me that they would decline any further operation to close the colotomy opening. The trouble caused by the opening was so slight that it was not worth while entertaining the idea of having even a trifling operation performed for the diverting of the fæces. One patient, though suffering no distress, said she would prefer to have an operation for the closure of the artificial anus.

In the following description of the operation of inguinal colotomy the steps which are followed after the abdomen has been opened belong equally to the lumbar operation, and, indeed, to colotomy wherever practised.

INGUINAL COLOTOMY.

When inguinal colotomy is performed the sigmoid flexure may be opened as high as possible or as low as possible. When opened as high as possible there is no fear of any prolapse, but there is little or no fæcal continence. When opened as low as possible, there is a liability to prolapse, but the normal reservoir for the fæces, the sigmoid flexure, is preserved, and incontinence is not apt to occur. The ideal operation would be a low sigmoid colotomy performed in such a manner as to permit the patient to have good control over the fæcal evacuation. I have recently practised an operation which seems to achieve this ideal:

High Sigmoid Colotomy.—In performing the operation for inguinal colotomy it is in perhaps the majority of cases desirable to open the sigmoid flexure as high as possible. In this manner the undoubted tendency to prolapse is lessened or even abolished; for the sigmoid is brought to the surface at a part where its mesentery is short, and the support of that segment of the bowel engaged in the operation is therefore firm.

The abdominal incision is made on the left side, in a manner precisely similar to that which is adopted upon the right side in the removal of the appendix; that is to say, that the muscles are split, as suggested by McBurney, and their fibres are not divided.

The incision is made with its centre at a line which joins the umbilicus to the anterior superior spine of the ilium, at a distance of $1\frac{3}{4}$ to 2 inches from the anterior superior spine. If the abdominal wall is very lax and pendulous, the incision may be made an inch higher even than this. The skin is divided for a length not exceeding two inches. When the fibres of



Fig. 148.—Colotomy—the muscles are split in the manner shewn: *a*, Fibres of external oblique; *b*, external oblique split; a small nick in the internal oblique, at the outer border of the rectus; *c*, the internal oblique and transversalis split.

the external oblique muscle are exposed, it will be found that the incision lies parallel to them. These fibres are split in the direction of their length, and are separated gently from one another. The muscular bundles of the internal oblique are then exposed; their direction is almost at right angles to that of the fibres of the external oblique. A separation of these muscular bundles is effected similarly in the direction of their length. This, which is not always an easy matter, is best effected by beginning the separation of them as near as possible to the outer border of the rectus. A small incision here will divide or separate the fibres of the internal

oblique and of the transversalis which lie beneath it, the transversalis fascia and the peritoneum being exposed. This small incision is lengthened by gently tearing the muscular fibres apart for a distance of about 1½ inches. A small retractor is then placed on each side of the wound, holding the muscles apart, and exposing the peritoneum, in which an incision of an inch, or rather less, is made. The cut edges of the peritoneum are seized with a clip on each side.

The forefinger is then introduced into the abdomen and the sigmoid flexure is sought. As a rule, there is no difficulty whatever in finding it and in bringing it to the surface. The simplest method of seizing it at once is to sweep the finger along the peritoneum on the outer side of the wound across the iliac fossa until the mesosigmoid is reached. A loop of the sigmoid is then drawn to the surface. I make a point in all cases of seeing that the part to be engaged in the wound is the highest part of the sigmoid. The desirability of this was first shewn by Mr. Harrison Cripps. As soon as a loop of the bowel is drawn out of the wound, its upper end is drawn upon until no more of the bowel will come out; at the same time the lower portion of the gut is returned through the wound into the abdomen. When the highest portion of the sigmoid has been reached, a good loop of the bowel is drawn out of the wound and its mesentery is made tense. A close examination of the mesentery is made, so that a bloodless spot can be chosen for the passage of the suture. This spot should be about 1 inch from the gut. The suture is now passed. In over 30 consecutive cases I have used only one suture for the support and fixation of the bowel. This stitch was first suggested by my colleague, Mr. Edward Ward. In introducing it I use a fully curved Hagedorn needle charged with thick Pagenstecher thread. The needle is passed from the centre of the incision on the upper or inner side of the wound, being introduced about ½ to ¾ inch from the cut edge, through the skin, external and internal oblique and trans-

versalis muscles, and the peritoneum. The clip which was put on to the edge of the peritoneum, immediately after it was incised, is drawn upon gently, so that it may be seen that the needle takes a good hold of the serous surface. The thread is pulled after the needle until only 6 inches remain on the outer surface of the skin. The needle now passes through the mesentery of the sigmoid at the bloodless spot already selected. During and after the time that this is done the loop of the sigmoid with its mesentery is held firmly in the surgeon's left hand. The thread is again pulled after the needle, which now is made to transfix the outer or lower margin of the wound, through all its thickness from peritoneum to skin. The thread is now pulled tight between the needle, and the end left hanging from the upper

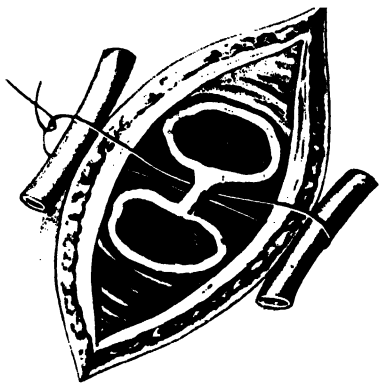


Fig. 149.—Colotomy. Shewing Ward's stitch in horizontal section.

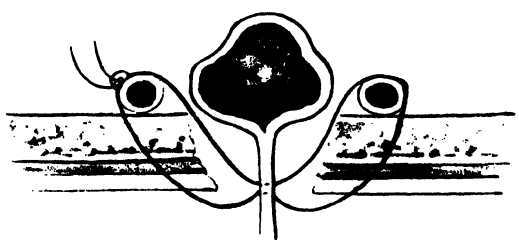


Fig. 150.—Colotomy. Shewing Ward's stitch in transverse section.

side of the wound. The needle is then returned through the same opening in the mesentery through which it has already passed, the needle is disengaged, and the stitch is ready for tying. On the upper side of the wound are the two ends

of the thread—one going into and through the whole thickness of the abdominal wall, the other emerging from the opening into the mesentery. On the lower side is a loop. When the suture is tied, a piece of medium-sized drainage-tube is threaded through this loop, so that the thread may not cut into the skin. As the two ends of the thread are knotted together, a similar piece of tube is placed in the loop so formed. The thread is drawn upon firmly and deliberately and a double knot is tied. The ends of the thread are then cut, being left about 2 inches long.



Fig. 151.—Colotomy. Operation completed.

This stitch affords a perfectly firm support to the loop of the sigmoid. It secures that a good loop of the bowel shall lie external to the skin, and it draws the skin-edges into the closest approximation with the mesentery on each side. There is no risk, therefore, of the bowel getting adrift or of the wound being opened more widely and a large amount of bowel being extruded. The suture, therefore, possesses every advantage over the glass rod, or strip of gauze, passed through the mesentery, in the methods adopted by many surgeons.

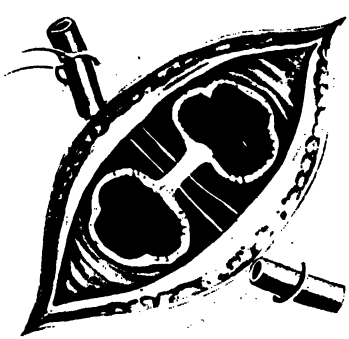


Fig. 152.—Ward's stitch, in "mattress" form, as seen in horizontal section.

No other stitches than this single one are necessary. If the skin incision has not been made unduly large, it will be found to fit the loop of the bowel quite snugly. If necessary, a silkworm-gut stitch may be passed at each end of the wound; in these a few fibres of a longitudinal muscular band on the bowel may be included, so as to give a fixed point of firm union at each end. This, however, is not necessary, and is to be performed only when an unduly large wound through the abdominal wall has been made.

Any loose appendices are now ligated at their attachment with fine catgut, and cut away.

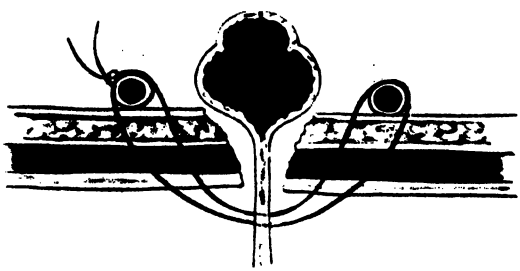


Fig. 153.—Ward's stitch in "mattress" form, as seen in transverse section.

A square of boiled dental rubber, or of oiled silk, is now applied over and around the loop of the bowel, and an external dressing of wool applied. The whole operation lasts from ten to fifteen minutes and may be done under local anæsthesia.

The supporting stitch may also be passed in the same manner as a mattress suture. It is this form which Mr. Ward now uses. The details are shewn in the annexed drawings. My own preference is for the first form of the stitch.

In order to keep the bowel from action and to quiet the possible unrest of the patient, a hypodermic injection of $\frac{1}{6}$ or $\frac{1}{4}$ of a grain of morphine may be given, and repeated at the end of twenty-four hours.

The time at which it is necessary to open the sigmoid flexure varies much in different cases. If there be an acute or subacute obstruction, it may be imperative to open the gut at once; in such circumstances the use of a Paul's tube is essential, for it is only in this way that the wound and its immediate area can be kept free from contact with fæcal discharge. If, however, there be no undue urgency, at least three days may be allowed to elapse before the intestine is incised; and in some instances as long as a week may be allowed to pass.

I have in many cases opened the bowel at the end of two, three, or four days, and have allowed the supporting stitch to remain in for several days longer. It is true that until this stitch is removed the bowel does not empty itself quite satisfactorily, but there is free escape for flatus, and for fæces in sufficient amount to prevent distress. The bowel is opened, as a rule, by an incision with the knife of a Paquelin cautery. The opening is made lengthwise into the intestine, and at first should be approximately an inch in length. The cautery should be of a dull red heat, and the division of the coat of the gut made slowly, so that hæmorrhage is prevented. As soon as the lumen is freely exposed it will be seen that the two openings leading from the surface into the proximal and distal limbs of the eventrated loop are separated by a well-marked spur, the end of which lies well above the level of the skin. It is, therefore, a physical impossibility for fæces to pass onwards into the distal opening: they must first escape from the proximal opening on to the surface. Through the distal opening, however, some astringent or antiseptic lotion can be introduced which will pass down over the growth and out of the anus, through a rectal tube. An ulcerating growth in the bowel can thereby be rendered both cleaner and sweeter, and that condition of irritating, ichorous discharge which is sometimes seen can be lessened or prevented.

Low Sigmoid Colotomy.—I have recently performed an operation having for its objects the provision of a controllable

artificial anus and the preservation of the normal function of the sigmoid flexure. The sole disadvantage of the method just described is that the fæcal material as soon as it reaches the sigmoid flexure is free to escape on to the surface. The sigmoid flexure should act, and in health does act, as a fæcal reservoir. If, there-



Fig. 154.—Low sigmoid colotomy. Shewing the bridge of skin under which the upper closed end of the sigmoid flexure, which has been cut through as low down as possible, is passed. The lower incision is shewn much larger than is necessary.

fore, it is opened *as low down as possible* rather than as high up as possible, fæcal material coming down the descending colon will not instantly be discharged upon the surface, but will be collected and detained to a convenient time in a capacious loop of bowel destined for that purpose. As a rule, when the sigmoid has been opened low down there has been a prolapse of the gut through

the opening. This can be prevented by the method now to be described.

The operation is performed in the following manner:

The abdomen is opened by the muscle-splitting incision just described. As soon as the sigmoid is exposed it is drawn *upwards* as far as possible until there is a tight length leading to the rectum. At this point two clamps are placed, and the bowel is divided between them. Both ends of the gut are now infolded and closed by suture. (The bowel may be crushed, ligatured and closed in, if desired.) The distal end of the bowel is fixed to the lower angle of the wound by a couple of stitches which include the peritoneum and the wall of the intestine. The upper end is freed a little, so as to render it more mobile without denuding it of its blood-supply, and is brought out of the wound as far as possible. A few stitches fix it to the peritoneum, and the muscles are allowed to return to their former position. The upper closed end of the gut is now treated in one of two ways: either it is, if freely mobile and of good length, passed upwards and inwards under a bridge of skin, made by undermining the skin on the inner

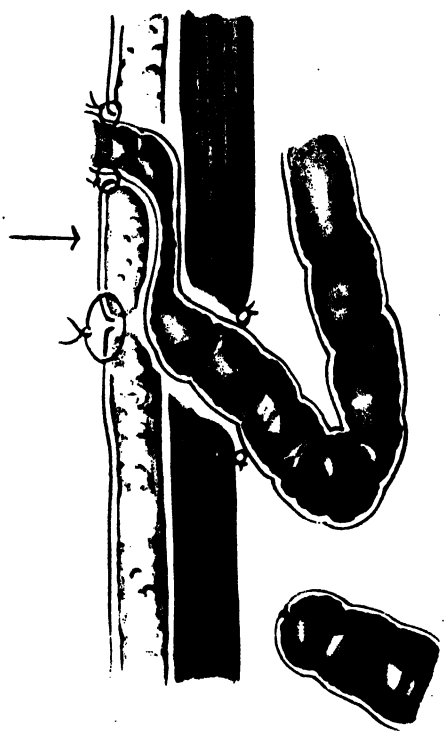


Fig. 155.—Low sigmoid colotomy. Section shewing the lower end closed and returned within the abdomen, and the upper end brought to the skin. A pad pressing in the direction of the arrow prevents leakage.

side of the wound for an inch and a half; a second smaller incision is then made through which the end of the bowel is pulled, and the original wound is closed. Or, if the bowel be but little mobile, being held by a tight mesentery, it is brought at once to the skin surface of the original wound, being twisted on its axis for half a circle.

If the former method is possible it is the more desirable; for after the bowel has been opened, the subcutaneous part of it may be so compressed by a pad fixed upon an abdominal belt as to be perfectly controlled,—controlled so efficiently, indeed, as to prevent even the passage of flatus, to allow which to pass the pad must be lifted away from the abdomen.

The opening of the bowel is left for two, three or four days, as seems necessary.

I believe it is to Wyeth, of New York, that we are indebted for this suggestion as to the continued usefulness of the sigmoid reservoir.

THE LUMBAR OPERATION.

Lumbar colotomy is performed in a manner precisely similar to that which is adopted in the inguinal operation; the sole differences are in the position chosen for the skin incision and in the fact that the descending colon, which is not at all or scantily provided with a mesentery, is opened instead of the sigmoid flexure. The incision which is most convenient is that which is generally known as Bryant's incision.

The patient lies well over on the right side, and in the hollow of the right loin a firm, rounded sand-bag is placed.

The incision is oblique and falls upon the skin between the last rib and the iliac crest.

The line of the colon is marked on the surface from a point half an inch behind the middle of the line joining the anterior and posterior superior spines vertically upwards. The centre of the incision lies upon this line.

The incision divides the skin, thick subcutaneous tissues,

and the muscles down to the fascia lumborum, which is opened by a small incision. The opening is widened by gentle tearing. The fat around the kidney is now exposed and is gently displaced or torn away with the fingers. In front the peritoneum will be seen.

The peritoneum is then deliberately opened on the outer side of the colon. When this has been done, there is no difficulty whatever in discovering the colon. As a rule, it comes unbidden to the surface and is seized at once. If it should not do so, the left index-finger is passed into the wound towards the spine, and is made to sweep along the front of the kidney until it is felt to meet the colon, which is hooked upwards and drawn out of the wound. By pulling gently upon the colon the peritoneum on each side of it is also drawn upon, in such manner as to fashion a sort of mesocolon. It is through this mesocolon that Ward's stitch, already described and illustrated, is passed. Mr. Ward devised this most satisfactory suture expressly for the operation of lumbar colotomy, and it is safe to say that no method for the performance of the operation approaches this one, so far as the perfect character of the opening and, therefore, so far as the comfort of the patient is concerned.

In some patients the depth of the wound may make it necessary or desirable to introduce a small drain in the posterior half, or possibly in the anterior half also, in order to prevent an accumulation of serous fluid in so deep a pouch. In rarer instances the wound from the skin to the peritoneum may be of so great a depth that the colon cannot be made to reach the surface. In such circumstances there is nothing to be done but to close the wound and to open the abdomen in the manner already described by an incision for the performance of inguinal colotomy. Such a condition of things, it is true, is rarely met with, but I was unfortunate enough to experience it in one case.

The difficulty due to an extremely short mesentery may

also be encountered in inguinal colotomy. If so, it may be overcome in one of two ways: either the parietal peritoneum may be stripped from the edges of the abdominal wound and tucked down to the sigmoid flexure by a series of sutures, the opening of the bowel being delayed for several days; or the bowel may be cut completely across, and each cut end gently stripped up until it can be made to reach the surface, or, better, to project well beyond it; the bowel is then stitched to the skin. A part of the ends may slough, owing to defective nutrition, but enough will remain to ensure an adequate opening on the surface.

CHAPTER XXIV.

ENTERO-ANASTOMOSIS, LATERAL ANASTOMOSIS, OR SHORT-CIRCUITING.

By lateral anastomosis, or short-circuiting, of the intestine is understood the creation of a communication from the bowel above to the bowel below an impenetrable or irremovable stricture. A lateral anastomosis may be used either as a final, perhaps the only possible, operation, as in cases of growth of the intestine causing partial occlusion, when secondary de-



Fig. 156—Entero-anastomosis (isoperistaltic).

posits in the liver or elsewhere are already present, or as a temporary measure, to give present relief to urgent symptoms, and thereby to prepare the way to a later resection of the growth. If, for example, there be a large, adherent, irremovable malignant mass in or near the cæcum which is causing intestinal

occlusion, the ileum above the growth may be united to the colon at any point well beyond the growth—to the transverse colon or the sigmoid flexure, for example. The operation of short-circuiting is one of frequent use and of great service in any part of the alimentary canal. Gastro-enterostomy for pyloric obstruction, entero-anastomosis, ileosigmoidostomy, are all operations that have served the surgeon well.

It is impossible, in any brief statement, to disclose the various indications for the performance of entero-anastomosis, but a few of the more important may be named.

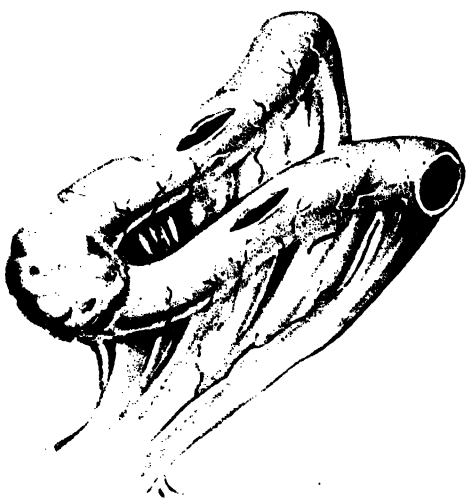


Fig. 157.—Entero-anastomosis (antiperistaltic).

1. In intestinal obstruction due to growths in the large or small intestine, where primary resection is impossible or inadvisable. The performance of enterostomy, formerly much practised, is considerably curtailed if this indication be observed. Lateral anastomosis in these circumstances is as simple and as safe as enterostomy, and is free from all the unpleasing attributes of a fæcal fistula.

2. In cases of simple stricture of the intestine due to cicatricial contraction following strangulated hernia, etc.

3. In cases of tuberculous disease of the intestine with extensive and inseparable adhesions, with the matting together of many feet of intestine in intricate confusion.

4. In some cases of multiple adhesions due to recurrent appendicitis, before or after the removal of the appendix, when symptoms of intestinal difficulty are present.

5. As a part in the operation of intestinal exclusion.

The range of usefulness of this operation is considerable,

its safety remarkable, and its performance as simple as that of any abdominal operation. In comparison with end-to-end anastomosis it presents the undoubted advantage of having the line of anastomosis completely encircled by peritoneum. There is no weak spot, as there is at the gap in the mesentery. Leakage, therefore, and difficulty of suture have not to be reckoned with; the only point requiring care and judgment is the selection of the most fitting place for the anastomosis.

In cases of obstruction due to growth a point some distance above the growth should be selected, for that condition of infection and ulceration of the mucosa which prevents the healing of a wound in end-to-end anastomosis may also wreck a lateral approximation. It is just as essential in this operation, as in resection, to suture only healthy portions of the bowel. Lateral approximation should not be made, therefore, too close to the growth on either side, and portions of the bowel alone should be selected which permit of ready apposition without drag or tension.

So far as the means of effecting the junction are concerned, it is only necessary to say that no other method than that of simple suture should ever be considered. In the early days of my experience I used the Murphy button to effect an ileo-sigmoidostomy, and despite the fact that the heavier end was placed in the sigmoid, the button made its way into the cæcum and caused ulceration and perforation. Of the method of simple suture, one may safely claim that it is as easy as any other method; that with practice it can be performed with equal rapidity; that disaster to the suture-line is unknown; that it leaves nothing behind which can, in the after-days, be a source of danger, and that in actual practice it is undoubtedly the most satisfactory. In short, all its attributes are those of excellence: it leaves nothing to be desired.

The following is the method I adopt: The appropriate loops of bowel having been chosen, they are drawn out of the abdomen and clamps are applied. It is necessary to ensure

that the loops to be united are applied to each other so that they are isoperistaltic. In the small intestine this is perhaps of little importance, but when the small and the large intestine are applied, it is undoubtedly an advantage. This disposition of the parts is ensured by seeing that the proximal portion of the gut is always placed near the pivot end of the blade of the forceps, and the distal portion of the gut towards the tip of the blade. The forceps so embracing the bowel are now made to lie side by side, and hot moist compresses surround them, and a special rolled compress lies between them. The suture is then applied. The needle is the usual curved needle, and the thread is the finest Pagenstecher. A continuous seromuscular suture is first introduced, along a line about 2 to 3 inches in length. The suture is knotted after the first stitch and the end is left long; it is then continued without interruption or knotting. The suture-line lies about ¼ inch from that portion of the bowel most distant from the mesentery, on the sides of the bowel which, in this position of the clamps, are in contact. After the suture reaches the portion of bowel at the tip of the clamps' blades, the needle is laid aside. The intestine in front of this line of suture is now opened by a straight incision about 2 inches in length, which divides all the coats down to the mucosa. As the knife cuts through these coats they retract, until, by the time the mucous membrane is reached, an ellipse of it lies in between the wound-edges. This ellipse is removed; a snip of the scissors is made through the mucosa at one point, and the scissors are then carried around the whole ellipse until it is free. The same is done with each portion of the gut. There will be no bleeding from the cut edges of the intestine, for the clamp which holds it acts as a temporary hæmostatic. The lumen of each portion of the bowel is emptied and thoroughly cleansed with gauze swabs, which are thrown away as soon as they are soiled. Care must be taken that neither the fingers of the surgeon nor of his assistant nor any of the parts around are soiled with the intestinal contents. The inner su-

ture is now introduced, beginning at the proximal end of the incision. A similar needle and the same size of thread are used. The suture embraces all the coats of the gut. After the first stitch the thread is knotted, the end left long, the suture then continued along the posterior margin of the incisions to the distal end of the wound, and, finally, the suture is continued around the anterior margins until the point of starting is reached, when

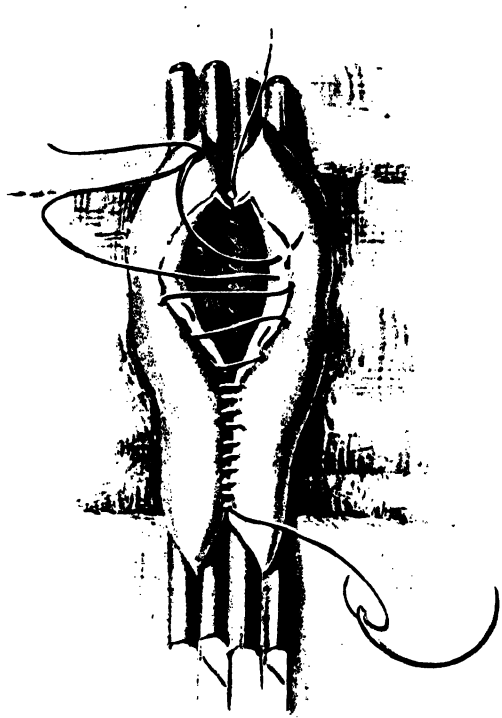


Fig. 158.—The inner suture in lateral anastomosis to shew the infolding of the mucosa which results. A loop of the suture lies on the mucous surface.

the end originally left long is tied with the end in the needle and the threads cut short. This inner stitch secures a perfect apposition, which is water-tight, and it is drawn sufficiently tight to secure the vessels in the cut edges. As each stitch is passed the thread is drawn upon with sufficient tension to lift up those portions of the intestine into which the needle has next to pass. The stitch is continuous throughout; there is no fear

of its causing a puckering of the wound-edges. With this suture special care must be taken to infold the mucosa. This may be done by changing the suture when the posterior part of the intestine has been sutured. When this point is reached, the needle is passed from the mucosa of the bowel which lies to the surgeon's left through all the coats to the serous surface. Then on each side the needle picks up a piece of the edge in a suture which lies parallel to the cut margin, the loop of the suture being always on the mucous surface (Fig. 158). After the completion of this suture the clamps are removed, and a general cleansing of the bowel and of the hands is made, for the mucosa, which is probably infected, is now closed off. It is often desirable for the surgeon to change his gloves. If any point in the cut edges shews any sign of bleeding, an interrupted suture is introduced and tied with sufficient force to arrest the hæmorrhage. The first needle, which carried the seromuscular stitch, is now picked up and the suture continued round in front of the inner stitch and about $\frac{1}{4}$ inch from it, until the point from which it started is reached. The end of this outer suture, if dragged upon by an assistant, will facilitate the introduction of the stitch around the anterior half of the wound. The two ends of the suture are now tied and cut short and the anastomosis is complete. A reference to the diagrams used in the description of the operation of gastro-enterostomy will here be useful.

A junction between two portions of the bowel effected by this suture is water-tight at once. The inner suture secures that. It is remarkable how rapidly the outer suture, securing accurate peritoneal approximation, ensures a firm union. In one case, a woman of sixty-seven, I performed ileosigmoidostomy for acute obstruction depending upon a growth in the cæcum. After the anastomosis was complete an assistant stretched the sphincter and I milked a very large quantity of thin fæcal material through the opening into the sigmoid and rectum. The patient died twenty-three and one-half hours

after the operation, and the suture could hardly be recognised, so perfectly was it sealed off by accurate peritoneal adhesion. The general appearance of the parts was such that it was difficult to believe that so perfect a healing had been possible in so short a time.

The same technique is adopted in all circumstances. The only difficulty that I have met with is that in some instances the mesosigmoid is so short that the bowel cannot be drawn outside the abdomen. I have found that a pair of Doyen curved clamps, applied so that the concavity is forwards (towards the operator), is then a help. If these cannot be used, then the sigmoid must be temporarily held by an assistant.

CHAPTER XXV.

ENTERECTOMY.

ENTERECTOMY, or the removal of a portion of the intestine, may be performed upon the small intestine, in any part of the colon, or at the ileocæcal junction.

Removal of a portion of the bowel is necessary in the following conditions:

1. In new-growths.

2. In stricture of the intestine due to former or present ulceration, most frequently tuberculous in character, or following upon strangulation.

3. Gangrene of the intestine, due to strangulation in a hernial sac, or occurring in intestinal obstruction.

4. Irreducible intussusception, associated with growth, simple or malignant.

5. In some forms of perforation of the intestine where two or more wounds lie close together, as in gunshot wounds.

6. In extensive lacerations of the intestine or of the mesentery, of the kind found in "buffer" accidents, or as the result of a bayonet or stab-wound.

7. In certain cases of fæcal fistula, designedly or accidentally produced.

8. In cases of growth in the mesentery when the vascular supply of the bowel is endangered.

The subject will be considered under the following headings:

Resection of the small intestine.

(*a*) For growth or stricture, or in cases of mesenteric tumour when the vascular supply of the gut is involved.

(*b*) In cases of gangrene dependent upon strangulated hernia or in acute obstruction.

Resection of the cæcum.

Resection of the large intestine.

(*a*) For growth.

(*b*) For growth causing acute obstruction.

RESECTION OF THE SMALL INTESTINE.

(*a*) **Resection of the Small Intestine for Growth or Stricture.**—Growth of the small intestine is infrequent. I have only thrice been called upon to remove malignant growths from the ileum or jejunum. Tuberculous stricture following upon ulceration is occasionally seen, and in some instances the thickening in the gut may be so marked as to cause a strong resemblance to primary growth.

The abdomen is opened, as a rule, through the middle line. If the tumour, perceptible before the operation, seems fixed in any part of the abdomen, the incision may be made directly over the most prominent portion of it. The abdominal incision is made in the usual manner, and the hand is introduced into the abdomen and a general examination of the parts is made. If, on careful exposure of the growth, it is found that a decided obstruction is caused by it and that the gut on the proximal side is acutely distended, no resection operation can be undertaken. Enterectomy, followed by primary suture in cases of intestinal obstruction due to growth, is doomed to failure. A lateral anastomosis between the bowel above and the bowel below the growth will then be undertaken. If, however, all the conditions are favourable for resection, this should be done.

The bowel is first carefully isolated. There may be adhesions binding the growth to the abdominal wall, to a neighboring coil of intestine, or, as is most commonly the case, to the omentum. Many of these adhesions give way under gentle pressure or with gauze stripping. They should always be detached firmly but gently. Roughness and impatience are out of place. Omental adhesions are ligated off about 1½ to

2 inches from the growth if possible. If any part of the intestine is adherent to the growth, it should be separated with especial care. In three cases of my own (two of growth, one of tuberculous disease) a separation was quite impossible, and the adherent loop of bowel had to be excised, a double enterectomy being performed. On a subsequent examination with the microscope the adherent loop was found, in each case, to be invaded extensively by growth. In cases of tuberculous disease the adhesions are even more binding and more complex than in cases of growth.

The adhesions having been separated, the involved loop of gut is drawn well out of the abdomen, so that the full ex-



Fig. 150.—Ligation of omentum. The interlocking ligatures.

tent of the disease and of the glandular enlargement can be seen. The limits of the excision having been determined upon, the large swabs wrung out of sterile hot salt solution are introduced. Two layers are used in the customary manner. The deeper layer that is first introduced consists of larger swabs, which remain unchanged throughout; the more superficial layer consists of smaller swabs which are changed as soon as soiled. No part of the abdominal contents but that being dealt with should, at any time, come into view.

The intestine having been isolated and the general peritoneal cavity shut off by the packing of swabs, the resection is begun. In the case of the small intestine it is always possible

to do this outside the abdomen, and there is every advantage in so doing it. The limits of the gut to be removed being determined, the intestinal clamps are applied. Four pairs are necessary two pairs at each point of section. If the intestine is at all distended with faeculent material or with flatus, the lower

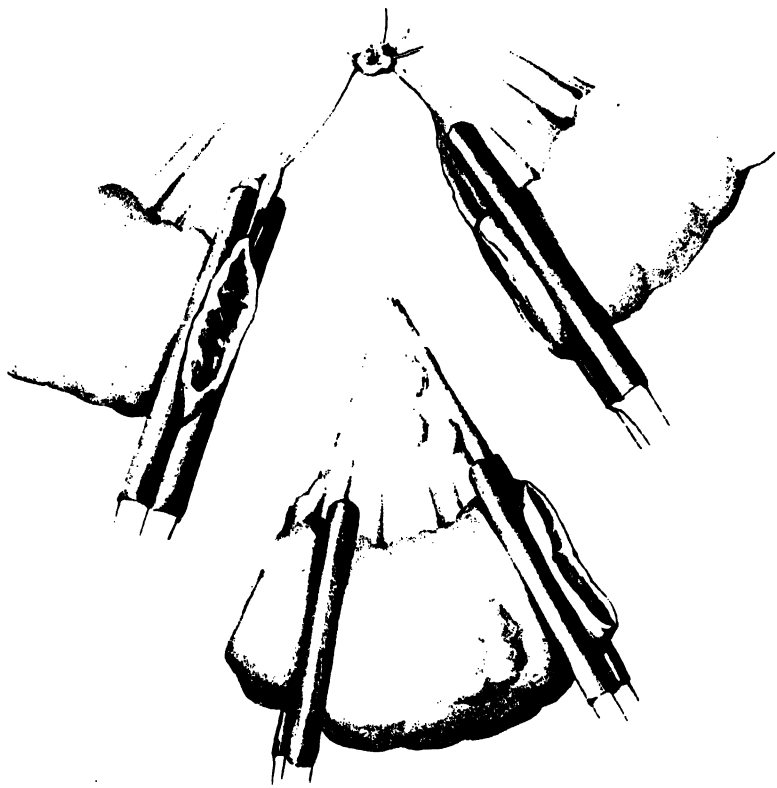


Fig. 100. Enterectomy. Removal of growth of intestine, with mesentery and glands. The parts are ready for an end-to-end anastomosis.

clamps can be first applied, the bowel divided, and the upper cut end drawn away from the wound, its clamp removed, and the bowel allowed to drain away its contents into a dish. The upper clamps are then applied and the intestine between them divided. As a rule, however, no emptying of the intestine is

necessary, and the clamps both above and below may be applied at once. In placing them in position it is important to remember that they must not be at right angles to the longitudinal axis of the intestine, but that they must lie obliquely, so that their tips approach one another. A triangular portion of mesentery with its portion of bowel is therefore partly included in the grasp of the clamps, the apex of the triangle being towards the root of the mesentery, the base being, of course, the bowel to be removed. By so applying the clamps an adequate blood-supply for the cut ends of the gut is assured, and a slightly larger

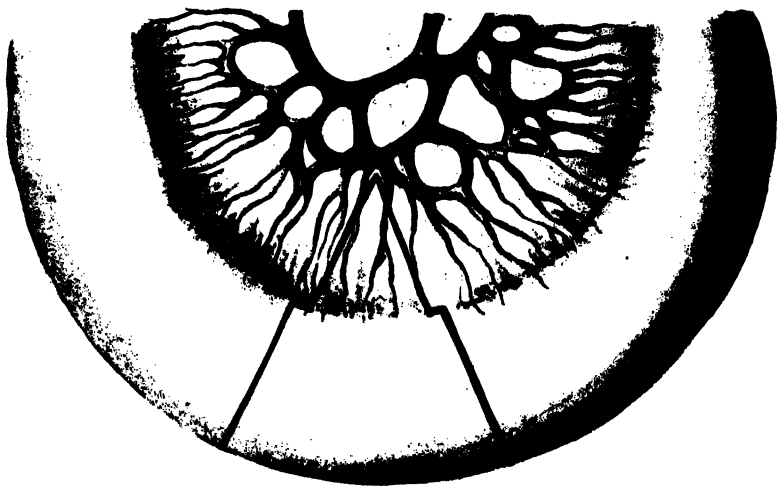


Fig. 161.—The lines of section of small intestine and mesentery in a case of enterectomy (Hartmann).

section of the intestine is left for the anastomosis. The bowel is now divided at each end, and the cut ends at once cleansed with many swabs wrung out of saline solution. As soon as the division is made, each end of the intestine is temporarily wrapped in a swab of gauze and carefully protected so that no soiling of any part of the operation area by contact with a certainly infected mucosa can occur. The incision is carried onwards, obliquely into the mesentery, and any bleeding points at once seized with clips. Or, as is my usual practice, the apex of the wedge of mesentery to be removed is found and isolated

and a broad clip of my own pattern is applied to it. The clip is squeezed home and allowed to remain for a few seconds. When it is removed, a deep groove will be seen, all except the vessels and the peritoneum having been squeezed away by the pressure of the forceps. Into the groove so left a catgut ligature or a fine Pagenstecher ligature is placed and tied. A clamp is then applied about 1 inch distal to the ligature, and the mesentery between them is divided. The remainder of the mesentery is now cut through on each side, and the whole affected loop is free. Some vessels in the cut mesentery near the bowel will require clipping. In this portion which is now removed will be the growth, a length of healthy bowel on each side, and a wedge of mesentery containing all the lymphatic vessels and glands draining the diseased intestine. The condition of affairs at this stage of the operation is represented in Fig. 160. A general cleaning-up of the operation area is now necessary. The inner layer of swabs is changed, the ends of the bowel are cleansed again, and the hands are well rinsed in fresh sterile salt solution. The approximation of the divided ends by suture is now begun. The clamps are drawn together and laid side by side, and wrapped around with hot moist gauze. If the upper opening of the bowel is rather larger than the lower, as may be the case, a longitudinal incision is made into the lower portion along a line most distant from the mesenteric attachment. The stitches are now introduced. That portion of the bowel at the mesenteric edge is first stitched, and very

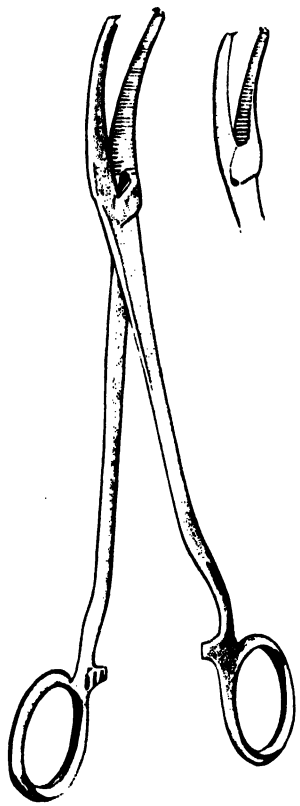


Fig. 162.—Two sizes of Moynihan's forceps (made by Down Brothers, London).

especial care is taken with the first few turns of the needle. The first stitch is seromuscular, and picks up the outer covering of the bowel about ¼ inch from the cut edge. The suture begins near the mesenteric attachment, and, in the first two passages of the needle, only the mesentery is pierced on each side. As the mesentery reaches the intestine its layers separate, leaving a triangular gap. It is the mesentery bounding the triangular gap which is picked up by the first turns of the needle. The suture is then continued, including the serous and muscular coats only (perhaps the submucous, or a part of it, also), until one-half the circumference of the bowel is united, until, that is to say, the part of the gut most distant from the mesentery is reached. The needle is then laid aside.



Fig. 163.—End-to-end anastomosis after enterectomy.

The inner suture is now introduced. This includes all the coats of the bowel, and ensures two results— a perfect mechanical approximation of the divided ends of the bowel and hæmostasis. It is not necessary to clip and to ligate any points in the cut edge of either end of the intestine. To introduce the stitch skilfully some practice is required. Owing to prolapse or retraction of the mucosa, it may be difficult to pick up, on the needle-point, precisely that amount of intestine which is necessary. The stitch may at first be drawn overtight; it is more likely, however, that it will not be drawn tight enough. I have found the best standard of the necessary degree of tightness that which results from a drag upon the thread from the last stitch of a degree sufficient to raise up, prominently, that part of the walls of the intestine into which the needle is next to pass. If the thread be drawn steadily and held firmly upwards, it raises the portion of bowel through which the needle last passed, and makes prominent that part which is about to

be caught up in the needle. It is the first two turns of this suture which are of the chiefest importance. By them the gap at the junction of the mesentery and of the bowel is closed, and a perfect serous apposition ensured. As the two openings lie side by side there are two triangular gaps, in the right and left divided ends of the intestine. The stitch is begun by being passed from the mucosa of the lumen of the bowel on the right, through all the wall of the bowel, and through that portion of the mesentery which has just separated from its fellow at the gap; from there the needle passes to the bowel on the left, transfixing all the coats, beginning with the separating layer of mesentery and passing then into the lumen of the bowel; from here it pierces the mucosa about ⅛ inch from the point of its last emergence through all the coats and through the other leaf of the mesentery; and, finally, it passes from the mesentery to the mucosa of the portion of intestine to the right, entering the lumen of this bowel through the mucosa about ⅛ inch from its original point of entry; the suture is tied and the end left long. (A reference to the annexed diagram will make the path of the needle clear.) The suture is now continued around the posterior half of the margins of the opening, embracing all the coats and being pulled fairly tight and even. No puckering of the gut need be feared. Each individual portion of the stitch must be separately tightened. If one loop be left slack, it cannot be tightened later without releasing all the stitch. The suture approximates first the posterior margins, and then, without change or interruption, is passed along the anterior margins until the end, left long at



Fig. 164.—End-to-end anastomosis continued.

the first stitch, is reached, when the thread is knotted and cut short. As the stitch passes along the anterior margin it is important to see that the mucosa is infolded. This may best be done

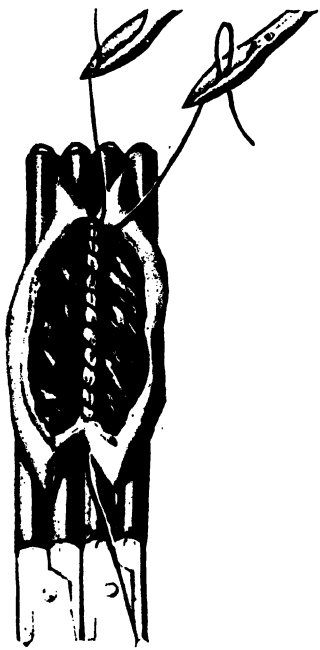


Fig. 165.—The first portion of the inner suture is almost complete. This is the point at which the character of the stitch changes, as shewn in next illustration.

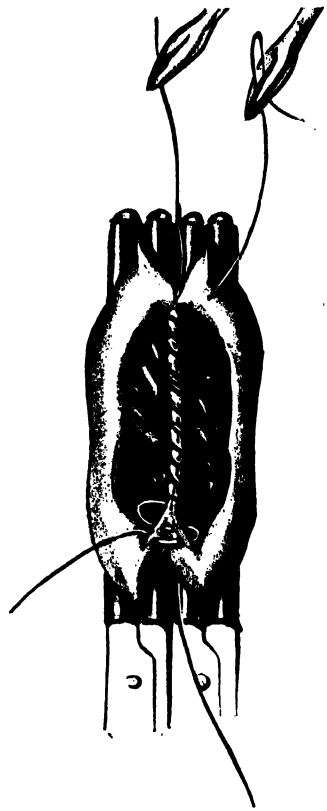


Fig. 166. — The inner through-and-through suture is changed here. The needle having reached the mucous surface of the left opening is passed in on this side again from mucous to serous surface. Then on the right side it passes from serous to mucous and back from mucous to serous surfaces, so that a loop is always left on the mucosa.

by changing the type of stitch. The needle is passed twice through the bowel on each side: from serosa to mucosa and back again to serosa on the one side, then similarly on the opposite side, so that a loop lies always on the mucous surface. As the suture is

tightened the mucous membrane is infolded. The last turn of this stitch passes from serosa to mucosa only, and there the knot is tied. The clamps are now removed from the intestine, as the ends are securely closed, in order to see if the suture-line bleeds at all. As a rule, the hæmostasis is perfect, but once and again a point will be found to bleed. A separate interrupted stitch is then passed to include this point. The arrest of the hæmorrhage being complete, the bowel is again gently washed, and the seromuscular stitch, laid aside for a time, is now re-started. The circuit is completed by carrying this suture along the anterior margins until the mesentery is reached. Two turns of the needle are then taken in the mesentery, and, finally, the needle is passed through the mesentery to the deeper (or posterior) side, where it meets the end originally left long. The two ends are tied and cut short.

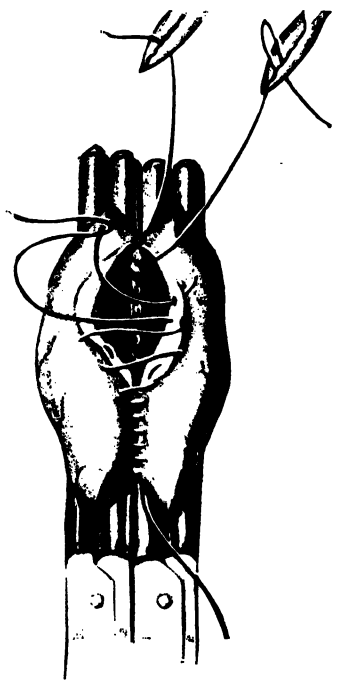


Fig. 167.—The inner suture continued. Note the loop always on the mucosa. When the stitch is tightened the cut edge of the mucosa is infolded and serous apposition secured.

A perfect apposition results. The weak point in the suture-line —the gap at the mesentery—is strengthened by both stitches, and a leakage is virtually impossible.

Throughout the whole procedure of suture introduction the greatest neatness, precision and fineness must be exercised, for here, more than anywhere, the surgeon's reward is in strict proportion to his deserts. A faulty suture will always cause leakage; nothing can prevent its doing so; a suture properly applied will secure perfect union.

The slit in the mesentery has now to be closed, and the bleeding points in the cut edges to be ligated. It is generally advised

that a through-and-through stitch should be used to close the mesenteric wound, but I have found such stitches a source, not infrequently, of trouble. A small vessel may be punctured and a hæmatoma rapidly forms, or at any point where the needle punctures some hæmorrhage may be started. I have, therefore, ceased to use sutures in the mesentery. The plan I adopt is that first suggested by my colleague, Mr. Littlewood, namely, to tie any bleeding point in the cut edge of the mesentery, and in the same ligature to include subsequently the exactly opposing point in the opposite cut edge. This is done at each point where a clip had been placed, and if the ligatures are not sufficiently close, a clip is introduced on the cut edge of one side, a ligature applied, the clip removed and at

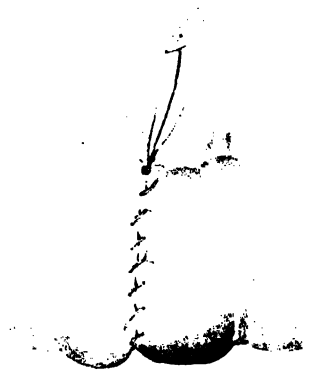


Fig. 168.—End-to-end anastomosis continued.

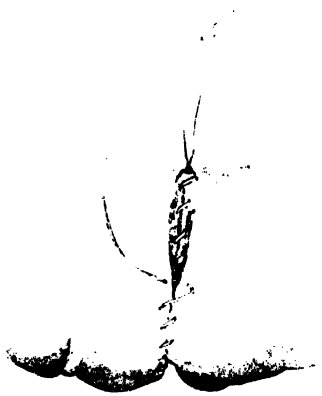


Fig. 169.—End-to-end anastomosis continued.



Fig. 170.—End-to-end anastomosis continued.

once put upon the corresponding point in the opposite edge, which is then taken in the same ligature.

In cases of growth in the mesentery, when the removal

of the growth involves the destruction of the blood-supply to the intestine, a resection of the gut cannot be avoided. So much of the bowel must be removed as seems, in each case, to be necessary. As a rule, there is no difficulty in seeing what the limits of such a resection must be, though to one unaccustomed to this branch of surgery, the extensive removal may seem surprising. The mesentery may be likened in its shape to an open fan, the smaller end representing the posterior attachment. This attachment is approximately six to

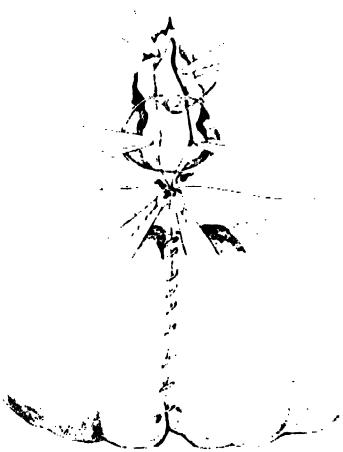


Fig. 171.—End-to-end anastomosis continued. Ligature of opposing points in the divided mesentery.



Fig. 172.—End-to-end anastomosis: the operation concluded.

eight inches in length, whereas the intestinal attachment of the mesentery is eighteen feet in length. A small wound in the posterior portion of the mesentery leaves perhaps several feet of the gut bereft of its blood-supply. A small wound in the terminal branches of the superior mesenteric artery is inevitably followed by gangrene of the bowel. If the wound be in the second series of vascular arches, it is possible for the circulation to be carried on through the free lateral anastomoses.

Resection for Tuberculous Disease of the Intestine.—Tuber-

culous stricture of the intestine possesses many points of especial interest. The disease is far from uncommon; it affects the sexes indifferently, and, owing to the fact that fibrous hyperplastic changes are frequent, a mistaken diagnosis of carcinoma may be made. The favourite sites of the disease are the lower end of the ileum and the cæcum; multiple strictures may exist close together, or they may be scattered at irregular intervals over several feet of the small intestine. When the ileocæcal region is affected, a diagnosis of chronic appendicitis or of malignant disease may be made. The fullest and most accurate account of this disease is that given by Mr. F. M. Caird in the "Scottish Medical and Surgical Journal," vol. xiv, p. 20, and I therefore quote at length from this article:

"The clinical features in the cases under consideration present a long history of failing health and indigestion associated with progressive emaciation. A personal and family history of tubercle can generally be obtained. The bowels are usually constipated, and purgatives are generally required. Severe colic, pain, and tenderness become gradually pronounced. A salient feature is the presence of loud borborygmi, which not only annoy the patient, but are frequently audible to bystanders. Vomiting may be frequent and often gives relief. Hæmatemesis is not met with, nor the passage of blood, although piles may co-exist. The abdomen becomes swollen and tense. Ladder-like patterns and marked peristaltic waves are seen. A tumour may be palpated in ileocæcal cases. Owing to the site of the lesion, complete obstruction does not readily occur, unless the stricture becomes impermeable and is blocked with some foreign body, or is complicated by adhesions to adjacent coils of intestine.

"The principles common to enterectomy for malignant disease—gangrene of the bowel, etc.—guide us in dealing with tubercular stricture, but the operative measures are frequently more difficult, and this is especially the case when we have to deal with adhesions. One may shell a loop of intestine affected with carcinoma from out a mass of surrounding, dense, inflammatory tissue, as in cases of adherent cæcal and sigmoid tumour; but in tubercle there is greater infiltration, and while

carcinoma may be shut in by the new fibrous tissue, the tuberculous process frequently bursts through the muscular and serous coats and infiltrates widely.

"The free, non-adherent strictures of the small intestine give rise to less trouble, but in any case an anxious element exists in the wide-spread implication of lymphatic glands, which may necessitate a far-reaching removal of mesentery and entail the sacrifice of healthy intestine. Or, again, some of the caseating glands may have softened or suppurated, and may rupture into the peritoneal cavity during manipulation, and so determine a fatal issue. In operating, then, let the patient be suitably prepared, cut wide of the diseased area, and see that the distended intestine above the stricture be thoroughly emptied. It is always important to plant the sutures in healthy, non-congested bowel.

"We have three classes, which may be treated as follows:

"1. If the strictured area be non-adherent, be localised and solitary, divide well above the proximal dilated portion, since there is a tendency for development of secondary tubercle at points of erosion and ulceration above the primary lesion. Always search for other strictures. Should there be multiple strictures separated by a lengthy interval of healthy intestine, without glandular implication, it is better to deal with each stricture individually than to excise an undue length of the alimentary canal.

"2. In dealing with an area of coils matted to each other, it is advisable to ascertain, in the first place, the extent and relation of the parts involved. One next carefully identifies the free, healthy proximal and distal intestine, and, applying clamps, proceeds to remove the entire mass. The mesenteries may be divided close to their origins, as this entails the ligation of fewer, if larger, vessels, and allows one to remove all the lymphatic glands. As already indicated, since the latter cannot well be dissected out without damage to the blood-supply of the intestine, it may be necessary to remove much bowel in clearing away the infected glands. Should the mass at any point be firmly adherent at one point to an adjacent healthy loop, it would appear needful to excise the implicated wall of that loop and so avoid the possibility of leaving a future focus of disease.

"3. When there are numerous adhesions of coils not only to each other, but also to adjacent strictures, so that the mass cannot be liberated without grave risk, it might be safer to sever the healthy proximal and distal coils of gut, and unite them end to end. The divided lumina in connexion with the diseased area may now be conducted externally, so as to open on the abdominal wall. Had this method of complete occlusion been practised in one of the cases, the patient's life might have been saved, and the tuberculous area thus left *in situ* might have undergone atrophy, or might have been removed at a later date, under more favourable circumstances. It is also probable that a short-circuiting by lateral anastomosis may occasionally give better results, as has been found by others, but, on the whole, radical measures are usually to be favoured."

(*b*) **Resection of the Intestine in Cases of Acute Obstruction or in Cases of Strangulated Hernia.**—Gangrene of the intestine as the result of strangulation within the abdomen or in a hernial sac depends in part upon the tightness of the constriction, in part upon the virulence of the micro-organisms which are present in the ensnared loop. An examination of the parts in such cases will shew that the acute infective process is most intense in this loop, but that it is by no means confined solely to it. The acute inflammation, leading on to ulceration or even gangrene, and the bacterial invasion of the coats of the bowel extend upwards and downwards in the bowel, but to a greater length and to a much more severe degree in the part above the constriction than in that below. In all resection operations undertaken for gangrene it is, therefore, necessary to cut through the bowel, on each side, wide of the gangrenous portion, but, especially, to remove freely on the upper side. The extent to which the bowel should be removed is not always easy to determine, for the gut, after division of the constriction, may, from a seemingly hopeless condition, slowly change its appearance and become almost normal. In all these cases, therefore, the intestine should be subject to the most careful exami-

nation, and the condition of the vessels of supply in the mesentery be determined. If the veins are thrombosed, and if the arteries have ceased to beat, the bowel, though it may recover its colour and appearance after release of the constriction, is probably not in a satisfactory condition for suture. In several recorded cases, and in some few observed by myself, an enterectomy performed in such circumstances has failed by reason of gangrene and leakage at the line of suture or from gangrene and perforation in the proximal portion of the bowel. It is better to err, if an error must be made, on the side of free removal. It is not the length of the bowel removed in these cases which makes the operation hazardous, for two feet of the intestine are removed as easily as two inches, but the inadequate removal of bowel seriously damaged and gravely infected, with vessels thrombosed, and the performance of an end-to-end anastomosis in a part of the bowel which cannot heal.

The removal of the bowel, therefore, must be free, especially upon the upper side. The anastomosis of the divided ends is carried out in the manner already described.

It is especially in these cases of overdistension of the intestine as the result of acute intestinal obstruction that the device already mentioned of emptying the intestine is of greatest service. The clamps on the lower side of the gangrenous loop are first applied and the bowel is divided between them. The proximal portion of the bowel is then freed from its mesentery to a degree which will permit its being drawn away from the wound for six to eight inches. The clamp which closes its end is then removed, and the gut allowed to empty itself of air and fluid motion. The bowel above the obstruction is emptied by "milking" until the overdistension is completely relieved. The clamps are then applied above, and the diseased bowel removed. The removal of the mesentery to the same extent as in cases of growth is not necessary. The method shewn in the diagrams annexed (Figs. 173 and 174) may be followed.

The length of intestine which can be successfully removed

has been investigated by experiment upon animals and, in cases of extensive gangrene necessitating resection, in man.

Dr. Alexander Blayney ("Brit. Med. Jour.," November 16, 1901, p. 1456), in recording the case of Mr. Hayes, in which 8 feet 4½ inches of intestine were successfully removed from a boy aged ten, on account of a crush of the bowel and mesentery, discusses in detail the question of the possibility of removing large portions of the intestine. He refers to the experimental work of Senn, Trzebicky, and Monari, and writes:

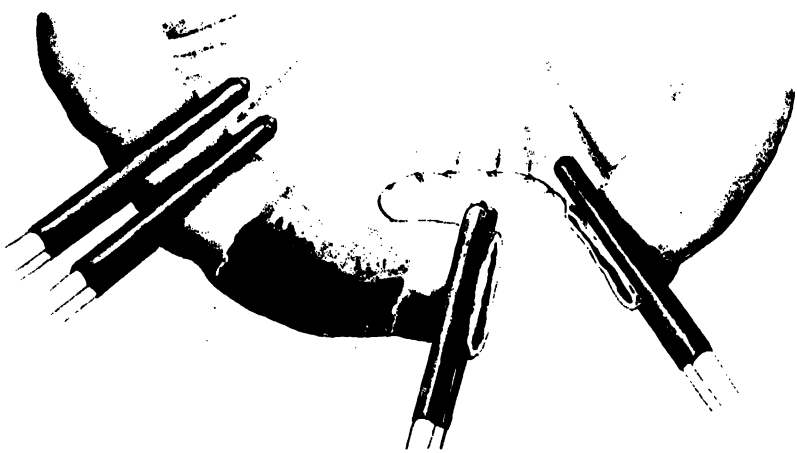


Fig. 173.—Enterectomy. The mesentery is ligated off close to the gut (after Kocher).

"Senn, who was the first to undertake the work, used as his material cats and dogs, on which animals he performed extensive resections of the small intestine in seven cases. Of these, however, only two were available subsequently for the purposes of the experiment. In both of these intense, long-continued, and eventually fatal marasmus with diarrhœa and increased appetite was the sequel of the resection. As a result of these experiments Senn came to the conclusion that the excision of more than one-third of the whole length of the small intestine was an operation dangerous to life,

productive of marasmus, and in this way eventually fatal. He directed attention to a compensatory hypertrophy of the intestinal wall which he found to be present in those cases which had survived for a considerable time. The conclusions of Trzebicky, as a result of 28 extensive resections of the small intestines performed on animals, were as follows: Resections of half the small intestine were tolerated quite well. Resections of two-thirds and upwards of the jejunum and ileum made such an inroad on the chemical and mechanical processes of digestion that the prolongation of life became

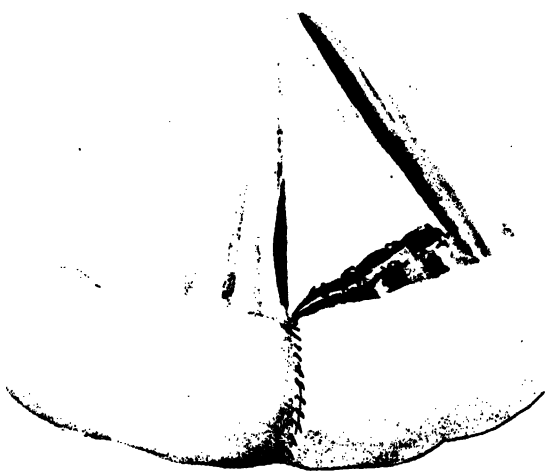


Fig. 174.—Enterectomy—folding of the mesentery (after Kocher).

impossible. There was incessant diarrhœa, followed at a later stage by vomiting; food was voided for the most part undigested, and, in spite of a craving appetite, the animals perished with symptoms of complete inanition. Trzebicky also observed that the effects of the resection of the beginning of the jejunum were more serious than those of resection nearer the ileocæcal valve—a result to be expected considering the wider, thicker, and more vascular condition of the jejunum. Transferring his results to the human subject and taking 560 cm. (18 feet 5 inches) as the minimum length of the small intestine, he declared that resection of one-half of it—that is, 280 cm.

(9 feet 2½ inches)—was quite permissible, provided no further complications were present. Monari goes even a step further. He believes he has proved by his experiments on dogs that seven-eighths of the intestine can be removed without the production of important interference with metabolism. He asserts that at least one-half of the small intestine may be removed in man without the person's metabolism being very much influenced for the worse. Like Senn, he found hypertrophy and hyperplasia of the gastro-intestinal tract in the dogs which had been operated upon and where the operation was well borne. The mucous membrane was thicker and more richly covered with villi. In those dogs which had died he found that the intestine left behind had become atrophic, the atrophy shewing itself in wasting of the villi and desquamation of epithelium. We thus see that these observers are not agreed among themselves as to how much intestine may be safely removed from dogs, while in their inferences in applying the results of their experiments to man two agree that removal of one-half is feasible, without producing any grave disturbances in assimilation, while Senn would assign one-third as the extreme maximum limit."

Dr. Roswell Park, of Buffalo, in recording a case of the successful removal of 265 cm., equal to 8 feet 9 inches, refers to a series of cases in which over 200 cm. were excised. These cases are shewn in the following table (Roswell Park, "Buffalo Medical Journal," April, 1903):

CASES OF INTESTINAL RESECTION WITH REMOVAL OF MORE THAN 200 CM. OF INTESTINE.

	Operator.	Amount Removed.	Result.
1.	Koeberle	6 ft. 10 in. (205 cm.)	Recovered.
2.	Kocher	6 ft. 11 in. (208 ")	"
3.	Dressman	7 ft. 2 in. (215 ")	"
4.	Shepherd	7 ft. 9 in. (234 ")	"
5.	Kukula	7 ft. 9 in. (237 ")	"
6.	Harris	7 ft. 10 in. (239 ")	"
7.	Hayes	8 ft. 4½ in. (248 ")	"
8.	Peck	8 ft. 5½ in. (251 ")	"
9.	Lawers	8 ft. 9 in. (265 ")	"
10.	Roswell Park	8 ft. 9 in. (265 ")	"
11.	Payr	9 ft. ½ in. (275 ")	"
12.	Maydl	9 ft. 4 in. (284 ")	Died three weeks later of inanition.

CASES OF INTESTINAL RESECTION WITH REMOVAL OF MORE THAN 200 CM. OF INTESTINE—(Continued).

	Operator.	Amount Removed.	Result.
13.	Fantino	10 ft. 4 in. (310 cm.)	Recovered.
14.	Monprofit	10 ft. 4 in. (310 ")	"
15.	Ruggi	11 ft. (330 ")	"
16.	Von Eiselsberg	11 ft. 8 in. (350 ")	Death after twenty-five days.
17.	Obalinski	12 ft. 2 in. (365 ")	Died.

In cases 9, 11, 14, and 17, from 8 to 30 cm. of large intestine were included in the measurements given.

In Obalinski's case (No. 17) the portion of bowel involved comprised almost the whole intestinal tract; the patient was a boy.

The point of chiefest importance is, however, not so much the extent of the bowel removed as the length of the bowel which remains. The result of many investigations by numerous observers goes to shew that the total length of the bowel in man may vary between 15 feet and 33 feet. A patient whose intestine was 30 feet in length would, therefore, be able to submit to a more extensive resection than a patient whose intestine was only 20 feet or perhaps less than this.

This series of cases shews clearly enough that the extent of the resection may be very considerable without involving any such serious risk as one might expect. It emphasises the point, upon which stress has already been laid, that a free removal of the bowel should be performed in any case where doubt exists as to its integrity.

In certain cases the band which has caused the constriction has been very narrow and has compressed the gut very tightly. A fine linear band of gangrene is thereby produced. If this band encircles the intestine, a resection operation is not always necessary. The damaged strip may be simply infolded and closed over by a continuous suture which picks up the serous and muscular coats. When the gangrenous part gives way, it will be shed into the lumen of the bowel and the firm line of union ensured by the suture will prevent any leakage into the peritoneal cavity. In some instances a very small patch of

gangrene or a perforation may be met with. It is in cases such as these that a partial resection has been successfully performed. The edges of the perforation are trimmed and sutures applied, or the damaged area is inverted. Caird has recorded ("Edin. Med. Jour.," 1895, p. 312) five cases of gangrene or perforation, occurring in strangulated hernia, which were treated by inversion. In some cases of Richter's hernia, with gangrene limited to a very small area opposite the mesenteric attachment, this method may be adopted. But it is to be remembered that the walls of the bowel around the damaged area are infected and but little likely to lend themselves to safe suture or to sound healing. The operation of inversion, though occasionally advisable, is probably not so safe a procedure as resection.

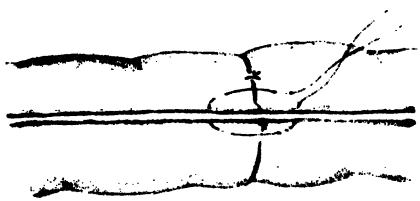


Fig. 175.—Mitchell and Hunter's suture for application at the mesenteric attachment.

In all operations where the bowel has been strangulated and has become gangrenous the most minute precautions must be taken to avoid contamination of the operation area in the handling of tissues which are infected with swarms of the most virulent organisms.

In some instances the use of an omental flap or graft is of great service in strengthening the line of union.

In both the operations above described the removal of a triangular piece of the mesentery is desirable, for in cases of growth the glands are included in it, and in cases of gangrene, the vessels in the mesentery are seriously damaged, and the veins perhaps filled with septic clots.

In cases of multiple wounds of the intestine or in other rarer conditions the removal of this triangular piece of the mesentery is not necessary. The mesentery quite close to the bowel may be cut through along a line parallel to the intestine, and the bleeding points clipped and ligated. When the ends

of the intestine are stitched, the mesentery can then be folded upon itself in a pleat. It is said that in such a condition the suture-line at the mesenteric gap is likely to be more securely closed than when the mesentery is removed. Sir William MacCormac also claimed for this method that, since it interfered less with the vessels of the mesentery (the terminal branches only being clipped), gangrene of the bowel was far less likely to occur than when the deeper vessels of the mesentery were ligated. (See Figs. 173 and 174.) It is perhaps desirable to call attention to a very satisfactory stitch, introduced by Mitchell and Hunter, for the purpose of effectively closing the gap at the mesenteric edge. The diagram (Fig. 175) explains itself.

The following is a complete list of all recorded

CASES OF SARCOMA OF SMALL INTESTINE TREATED BY OPERATION.

1. Libman, *Mittheil. aus dem Grenzgeb. der Mediz. u. Chir.*, 1901, Bd. vii, p. 446.
   M. æt. eighteen.
   Acute abdominal symptoms twenty-four hours.
   Operation: Laparotomy. General peritonitis found. Died shortly afterwards.
   Postmortem: Perforation 7 × 8 cm. in jejunum, 2 cm. from duodenojejunal flexure, in centre of a large tumour which dilated the intestine at this point.
   Microscope: Lymphosarcoma.

2. Libman, *ibid.*
   M. æt. forty-two.
   Irregular pains in abdomen fifteen years.
   For some days abdominal tumour, growing rapidly and becoming painful.
   Operation: Laparotomy. Tumour of ileum adherent to iliac fossa, pelvis, great vessels, and bladder. Excised with about 10 cm. of intestine. End-to-end union with Murphy's button.
   Result: Died three days later of peritonitis.
   Postmortem: Tumour occupied ileum, 70 cm. from ileocæcal valve.
   Microscope: Spindle-celled sarcoma.

3. Hahn, *Berliner klin. Wochenschrift*, 1887, No. 25, p. 446.
   M. æt. nineteen.
   Ill some weeks. Marked constipation. Tumour in right loin. Diagnosed as movable kidney.
   Operation: Lumbar incision. Kidney found in place. Peritoneum opened and tumour found to be one of termination of ileum. Resection of tumour and cæcum. Ends of intestine tacked together and fixed in wound. Tube left in end of ileum.

Result: Recovery.
Microscope: Round-celled sarcoma.

4. V. Zuralski, "Beitrag zur Casuistik der Dünndarmgeschwülste," *Thèse de Königsburg*, 1889.
M. æt. forty.
Tumour in abdomen noticed fourteen months. Constipation. Recently pain. Large fluctuating tumour in middle of abdomen.
Operation: Laparotomy. Cystic tumour as large as a man's head removed with 5 cm. of small intestine from which it arose. End-to-end union.
Result: Cure.
Microscope: Spindle-celled sarcoma.

5. König, "Die Operationen am Darm bei Geschwülst," *Arch. f. klin. Chir.*, 1890, Bd. xl, p. 905.
F. æt. thirty-two.
Abdominal pain and wasting three months. Large tumour in left flank.
Operation: Vertical incision over tumour, which was adherent to abdominal wall, omentum, and small intestine. Excision of 60 cm. of small intestine, extending from duodenojejunal flexure downwards. End-to-end suture.
Result: Death in twenty-four hours.
Microscope: Sarcoma of small intestine.

6. Baltzer, *Arch. f. klin. Chir.*, Bd. xiv, 1892, p. 747.
M. æt. fourteen.
Abdominal pain about five months, especially in right side. Tumour noticed about four months; has grown steadily.
Operation: Exploratory laparotomy. Omentum found full of nodules like miliary tubercles.
Result: Death nine days later.
Postmortem: General peritonitis. Tumour of termination of ileum, invading cæcum.
Microscope: Lymphosarcoma.

7. Baltzer, *ibid.*
M. æt. fifty-two.
Abdominal pains, constipation, and wasting for seven months. Tumour in right side noticed one month.
Operation: Abdomen opened in right linea semilunaris. Growth of small intestine as big as two fists drawn out of abdomen and resected. End-to-end union.
Result: Death within twenty-four hours.
Postmortem: Union sound. Secondary growths in liver and omentum. The tumour had occupied the small intestine, three feet from the ileocæcal valve.
Microscope: Round-celled sarcoma.

8. Rutherford, *Glasgow Med. Jour.*, 1893, vol. i, p. 456.
F. æt. fifty-one.

Chronic obstruction two and a half years.
Operation: Enterostomy.
Result: Death in a few days.
Postmortem: Growth of lower end of ileum.
Microscope: Round-celled sarcoma.

9. Fleming and L. Steven, *ibid.*, 1893, vol. i, p. 455.
F. æt. twenty-seven.
Severe attacks of abdominal pain two months.
Tumour in left lumbar region.
Operation: Exploratory laparotomy. Removal found impossible.
Result: Death.
Postmortem: Tumour of jejunum immediately below duodenojejunal flexure.
Microscope: Round-celled sarcoma.

10. Waldenstrom or Akerberg, *Upsala lökereferen. fört.*, Bd. v, p. 3888.
M. æt. thirty-six.
Patient had for a long time suffered from hernia, which he kept back by a bandage. One day the hernia became strangled and was successfully reduced by a doctor. Seven months later the hernia again became strangled and taxis failed.
Operation: Herniotomy. Wall of intestine in sac found to be occupied by a tumour. No signs of strangulation. Reduction impossible.
Result: Death in ten and a half hours.
Microscope: Sarcoma of small intestine.

11. Nicolaysen, *Norsk Magaz. for Lägevid.*, R. 3, Bd. xv, Christiania, p. 12.
M. æt. twenty-eight.
Dyspeptic symptoms six weeks. Kidney-shaped tumour in hypogastric region.
Operation: Laparotomy. Tumour of small intestine removed. End-to-end union.
Result: Cured.
Microscope: Spindle-celled sarcoma.

12. Kétli and Dollinger, *Wiener med. Presse*, 1894, p. 1472.
M. æt. twenty-seven.
Constipation three years. Tumour noticed in abdomen one and a half years.
Operation: Laparotomy. Tumour as large as a child's head excised from upper part of jejunum. End-to-end union.
Result: Cured.
Microscope: Round-celled sarcoma.

13. Schiller, *Beit. zur klin. Chirurgie*, 1896, Bd. xvii, p. 63.
M. æt. thirty-six.
Abdominal pains without vomiting three and a half years. Tumour noticed one month.

Operation: Median incision. The tumour was found to occupy about half the small intestine; it was composed of a great number of small tumours, ranging from a bean to a pullet's egg in size. They seemed to be developed from Peyer's patches. Lateral anastomosis was performed with Murphy's button.

Result: Recovery from operation.

Anatomical diagnosis: Multiple lymphosarcomata.

14. Brault, *Archiv. Générales de médecine*, 1895, t. II, p. 25.

M. æt. twenty-three.

Intermittent pains in abdomen seven months. Tumour in abdomen three months. Before operation two tumours are made out—a large one in the left loin and a smaller one below the umbilicus.

Operation: Laparotomy. The smaller tumour seems to be in the root of the mesentery; the larger one is firmly adherent to all the intestine in the mesentery. Abdomen closed.

Result: Recovery from operation. Death in three months.

Postmortem: Both tumours arise from ileum—one at its commencement, the other near its termination.

Microscope: Round-celled sarcoma.

15. McBurney, *Annals of Surgery*, t. xxiii, p. 441.

F. æt. forty.

Attacks of colicky pain in abdomen for three months. No constipation or vomiting.

Operation: Median laparotomy. It was found that a tumour of the small intestine had caused an intussusception. The affected segment of bowel (21 cm.) was excised and end-to-end union effected with Murphy's button.

Result: Cured.

Examination of specimen: The tumour sprang from the submucosa of the small intestine; it was pedunculated and as big as an orange.

Microscope: Myxosarcoma.

16. Willy Meyer, *ibid.*, p. 443.

F. æt. forty-six.

Admitted with symptoms pointing to subacute appendicitis, and existing ten days. A few days later symptoms of intestinal obstruction came on.

Operation. An intussusception was found in the ileum near its termination; this was brought out and reduced. Then a little higher up a second intussusception was found and was also reduced. Then a tumour was felt in the interior of the intestine, and the affected loop was resected. End-to-end union with Murphy's button.

Result: Cured.

Microscope: Sarcoma.

17. Mermet, *Bulletins Soc. anat. de Paris*, 1896, p. 882.

F. æt. thirty-two.

Colicky pains in abdomen, with diarrhœa, four months. Tumour as big as head of fœtus at term felt in left lumbar and iliac regions.
Operation: Laparotomy. Tumour found to be one of the small intestine, about 1 metre from duodenojejunal flexure. Affected portion (20 cm.) excised; end-to-end union.
Result: Death.
Microscope: Round-celled sarcoma.

18. Engström, *Finska Lakaresallskapes Handlingar*, Helsingfors, 1897, Bd. xxxvii, p. 906.
F. æt. thirty-five.
Movable tumour as big as a fist noticed in abdomen five months.
Operation: Laparotomy. Tumour found to be one of small intestine Resection. End-to-end union.
Result: Cured. Recurrence at end of one year.
Microscope: Round-celled sarcoma.

19. Engström, *ibid.*
F. æt. forty-six.
Dyspepsia. Tumour below and to left of umbilicus noticed two months. Constipation.
Operation: Laparotomy. Affected loop of small intestine resected. End-to-end union.
Result: Cured. No recurrence five months later.
Microscope: Round-celled sarcoma.

20. Babès and Nanu, *Berlin. klin. Wochenschrift*, 1897, No. 7, p. 138.
M. æt. thirty.
Abdominal pains, especially in the left flank, with constipation and later diarrhœa. Ovoid tumour felt in abdomen.
Operation: Median laparotomy. Tumour of small intestine as large as two fists resected. End-to-end union.
Result: Recovery. Patient quite well one year later.
Microscope: Myosarcoma.

21. Vitrac and Laubie, *Journal de Médecine de Bordeaux*, 24 octobre, 1897, No. 43, p. 495.
Adult female.
Sharp pain in abdomen. Examination showed a tumour in the left half of the hypogastrium. Vomiting. Constipation.
Operation: Laparotomy. Pedunculated tumour as large as a fœtal head attached to free edge of small intestine. Resection of affected loop. End-to-end union.
Result: Cured.
Microscope: Sarcoma.

22. Heinze, "Ueber primäre Dünndarmsarcome," *Thèse de Greifswald*, 1897.
M. æt. forty-two.
Stomach symptoms five months, feeling of weight after meals. Tumour as large as a fist felt in left hypochondrium.

Operation. Tumour found to be one of jejunum. Excision of tumour with four feet of intestine from duodenojejunal flexure downwards. End-to-end union.
Result: Cured.
Microscope: Round-celled sarcoma.

23. Tscherniakowski, *Khirurgie*, Moscow, 1898, Bd. iv, p. 583.
M. æt. twenty-four.
Abdominal pains, weakness, and loss of appetite four months. Large tumour felt in left hypochondrium.
Operation: Exploratory laparotomy. Tumour found to be irremovable.
Result: Death twelve days later.
Postmortem: Tumour found to be one of small intestine.
Microscope: Round-celled sarcoma.

24. Petrow, *Lixtop. Russk. Chirurg.*, St. Petersburg, Bd. iii, p. 110.
M. æt. thirty-four.
Obstinate constipation three and a half months; abdominal pain one month. Tumour in left iliac region as big as a child's head.
Operation: Exploratory laparotomy. Tumour judged to be inoperable.
Result: Death in sixteen days from peritonitis.
Postmortem: Tumour of duodenojejunal angle; great enlargement of mesenteric glands.
Microscope: Lymphosarcoma.

25. Steiner, *Beit. zur klin. Chirurgie*, 1898, Bd. xxii, Heft 1, p. 1.
F. æt. fifty-seven.
Abdominal pains two years, colic attacks five months, tumour four months. Tumour below umbilicus, now as big as an adult's head.
Operation (Wölfler). Tumour found to be one of small intestine. Resection. Closure of ends, lateral anastomosis.
Result: Recovery. Recurrence ten months later.
Microscope: Myosarcoma.

26. Quensel, *Nordiskt Medicinskt Archiv*, 1898, No. 30, p. 1.
F. æt. sixty-two.
Acute intestinal obstruction six days before operation. Tumour felt in lower abdomen.
Operation. Tumour found to be of small intestine. Resection of 30 cm. End-to-end union.
Result: Death thirty-six hours later.
Microscope: Spindle-celled sarcoma.

27. Marwedel, *Beit. zur klin. Chirurgie*, 1899, Bd. xxiv, p. 104.
F. æt. forty-three.
Abdominal pain and obstinate constipation one year. Large tumour arising out of pelvis up to umbilicus.
Operation: Tumour found to be one of jejunum involving the mesentery and glands. Resection. End-to-end union with Murphy's button.
Result: Death in five hours.
Microscope: Myosarcoma.

28. Westermark, *Nordiskt medicinisk Arkiv*, 1899, Stockholm, Bd. x, No. 26, p. 1.
M. æt. fifty-two.
Constipation and flatulency several years. Painful and frequent micturition three months. Pain in lower part of abdomen. Then a tumour was noticed between the anterior superior iliac spine and the umbilicus.
Operation: Tumour of small intestine as big as a fist, adherent to abdominal wall and bladder. Resection of 30 cm. End-to-end union.
Result: Death six days later.
Microscope: Alveolar sarcoma.

29. Berg, *ibid.*
M. æt. forty-eight.
For some months patient had noticed a tumour in his abdomen which has gradually grown to the size of an infant's head. He has had no pain or other symptoms, but has wasted much.
Operation: The tumour is found to be situated upon a loop of small intestine which is greatly enlarged and recalls too-full stomach. The tumour had caused an intussusception. Resection of affected intestine. End-to-end union.
Result: Recovery. Recurrence five months later.
Microscope: Alveolar sarcoma.

30. Westermark, *ibid.*
F. æt. thirty-six.
Pains in lower abdomen and back some months. Three weeks ago a tumour was noticed in left half of abdomen. Constipation.
Operation: Tumour found to involve small intestine, not far from the duodenojejunal flexure. Resection. Lateral anastomosis.
Result: Recovery.
Microscope: Round-celled sarcoma.

31. Rheinwald, *Beit. zur klin. Chirurgie*, 1901, Bd. xxx, Heft 3, p. 702.
F. æt. twenty-five.
Stomach symptoms two years. Diagnosis of dilated stomach made.
Operation: Tumour found in small intestine near duodenojejunal flexure. Resection of affected loop. End-to-end anastomosis.
Result: Recovery.
Microscope: Spindle-celled sarcoma.

32. Rheinwald, *ibid.*
M. æt. forty-three.
Began with diarrhœa seven weeks before, followed by obstinate constipation. Obstruction five days before admission.
First operation: Enterostomy. After this a tumour was felt above the umbilicus.
Second operation: Resection of loop of small intestine (ileum) with tumour. Isoperistaltic lateral anastomosis with Murphy's button.
Result: Cured.
Microscope: Round-celled sarcoma.

33. Hawthorn, *Marseille médical*, p. 439, 1902.
F. æt. thirty-one.
Pain in lower abdomen since last pregnancy, twenty months before. Hard mass felt behind pubes, diagnosed as fibroid.
Operation: Laparotomy. Tumour proved to be as big as two fists and arising from the upper part of the ileum. Resection of 78 cm. of intestine. End-to-end union.
Result: Recovery. Recurrence two months later.
Microscope: Round-celled sarcoma.

34. Lange, *Hygiea*, Stockholm, 1902, t. 1, p. 373.
F. æt. forty-six.
No digestive troubles; slight constipation. Patient had noticed tumour in right side for some months. Diagnosed as a solid ovarian tumour.
Operation. Tumour found to be one of ileum near its termination. Partial resection of intestine. Suture.
Result: Recovery.
Microscope: Fibrosarcoma.

35. Lecène, *Thèse de Paris*, 1904, No. 196.
F. æt. seventeen.
Abdominal swelling five weeks. No pain, constipation, or diarrhœa. Recently some bilious vomiting. Examination shewed nothing but ascites, which was diagnosed as tuberculous.
Operation (Terrier): Median laparotomy below the umbilicus. Six litres of fluid flowed away. Tumour found on ileum about 20 cm. from termination. As patient's condition was bad, the abdomen was then closed.
Result: Patient did well for sixteen days. Then ascites re-formed. She had severe colic, and died a fortnight later.
Microscope: Round-celled sarcoma.

36. Lecène, *ibid.*
M. æt. fifty-one.
A year ago patient began to suffer from slight pains in the epigastrium. Recently more severe. Vomiting, constipation, distension of upper abdomen. Tumour extending from umbilicus to pubes.
Operation (Gosset). Tumour of small intestine found. Resection. Lateral anastomosis.
Result: Recovery.
Microscope: Spindle-celled sarcoma.

37. Steinthal, *Münch. med. Woch.*, 1904, pp. 751, 752.
F. æt. twenty-five.
40 cm. of jejunum removed, of which about 9 cm. were made up of a constricting spindle-celled sarcoma. The operation was performed on April 6, 1900; the patient was free from recurrence four years later.

38. Steinthal, *ibid.*
M. æt. forty-three.

Resection of lower end of ileum for growth 8 cm. in length. Microscopically, a small round-celled sarcoma. Operation December 6, 1900; the patient was free from recurrence three and a half years later.

39. Moynihan.
F. æt. thirty-nine.
Suffered from diarrhœa and wasting for eight months. Resection of 15 inches of jejunum for small round-celled sarcoma. Recurrence in fifteen months in abdomen generally.

40. Moynihan.
M. æt. forty-two.
Suffered from recurring attacks of partial intestinal obstruction for seven months. A tumour palpable in right iliac region. Resection of 11 inches of terminal portion of ileum for round-celled sarcoma: End-to-side anastomosis between ileum and ascending colon. Recovery. Operation in December, 1904. Patient quite well, February, 1906.

EXCISION OF THE CÆCUM.

The cæcum has not seldom to be excised on account of growth beginning within its limits or extending into or near to it from the ileum, ileocæcal valve, or ascending colon, and in cases of tuberculous disease. One remarkable feature of growths in this region is the shrinking which they cause in the length of the gut. One specimen which I have removed from a patient aged seventy-one measures 8 inches in length and comprises the lower portion of the ileum, the cæcum, the whole of the ascending colon, and the greater part of the transverse colon. This "telescoping" is seen constantly, but it never ceases to cause surprise when the growth comes to be examined.

When this portion of the intestinal canal is excised the general steps to be followed are similar to those which have already been described in the case of the small intestine. The incision is made over the growth, or along the outer margin of the right rectus, and the abdomen is opened and the general peritoneal cavity shut off with two layers of gauze swabs applied in the usual manner. It will be found that the omentum is spread out over the surface of the growth, and is firmly adherent to it. This must first be ligated off, piecemeal. The

ascending colon must then be freed from the posterior abdominal wall, to which it is often adherent. For this purpose the parietal peritoneum to the outer side of the colon is incised and raised up towards the colon. The stripping must then be continued towards the middle line, behind the termination



Fig. 176.—Removal of the cæcum for growth.

of the enteric mesentery, so that any enlarged glands—and of these there may be many—are made free also. The cæcum and the ascending colon, when affected either by growth or by tubercular disease, shew a marked tendency to the contraction of adhesions either with the omentum or with the fascia over the psoas and iliacus or with both. A careful and

painstaking separation of all these will, by the aid it gives to the later stages of the operation, be worth the expenditure of a little trouble. As a general rule the tumour-mass will by this means be rendered sufficiently mobile to permit of its easy withdrawal from the abdomen when the operation of resection is at once performed. In some few instances, however, owing to the density of adhesions or to the shortness of the enteric mesentery, or to the enlargement of glands, or to the stoutness of the patient, this may not be possible. In such circumstances the mesentery is tied off in sections and divided on the proximal side of the enlarged glands. The bowel can then be withdrawn without difficulty. The clamps are then applied. To the small intestine they are affixed in the usual manner that is, obliquely, and not at right angles to the long axis of the gut. To the large intestine they are applied at a part which is secure in its blood-supply. The vessels running to the colon can generally be seen, and can always be felt, and it is close to and on the proximal side of a vessel that they should be applied. Two pairs of clamps are applied at each end and the gut is divided between them. The ends to be anastomosed are carefully cleansed and washed with hot sterile salt solution. The ends of the segment to be resected are carefully guarded, so that no soiling of the operation area is permitted. If the mesentery has not been previously ligated, this is done now, a series of clips being applied and the peritoneum cut through distal to them. Ligatures are applied and the clips removed. The diseased portion of bowel and the mesentery and glands involved are now entirely removed, and the suture of the divided ends is begun. In many instances it will be found that there is some disparity in the size of the ileum and the colon. This is not always the case, however, for a gradually oncoming obstruction may have caused the ileum to dilate and its walls to become thickened to such an extent that it may equal or even surpass the colon in size. If, however, the ileum be the smaller, the openings may be

made more nearly equal by the oblique division of the ileum, by the making of a longitudinal slit in the ileum at that part most distant from the mesentery. When the openings are of the proper size, the clamps embracing them are laid side by side and the sutures are applied. The method already described for end-to-end suture in the small intestine is accurately followed. In the case of the colon, however, it is necessary to see that the posterior surface, which is bare of peritoneum, is covered in by the peritoneum which has been loosened up from the posterior abdominal wall in the attachment of the growth. As a rule, this can be done without difficulty. When the inner through-and-through suture is complete, the outer peritoneal suture is made secure. No pains are too great to expend upon this, for an intact covering of peritoneum must be furnished, a step which is not always easy of accomplishment. The details other than this are identical with those already described.

I have performed resection of the cæcum or ascending colon, with end-to-end anastomosis, in the manner described, on seven occasions. One patient died, the remainder recovered. The patient who died was a woman of forty-eight who suffered from a malignant growth in the ascending colon which had caused acute obstruction. This had been relieved by an ileosigmoidostomy, and resection was subsequently undertaken. The suture-line leaked, possibly because the mechanical part of the suturing failed, but probably because, as a result of the former obstruction, the gut on the proximal side was in an unhealthy condition. In two subsequent cases I have not attempted to make an end-to-end anastomosis, but have closed both ends of the gut securely and have then performed a lateral anastomosis. In one case a side-to-side anastomosis was successfully performed. This method of lateral anastomosis which I feel disposed to adopt as an almost unvaried procedure in the future, after resection of the cæcum, has certain considerable advantages over the end-to-end suture.

The ileum is, of course, freely mobile, and, after closure of its divided end, it can be moved with ease into apposition with any part of the ascending or transverse colon. The surfaces which are united are everywhere clad with peritoneum, and there can never be any anxiety as to the security and the permanence of their apposition. The operation of lateral anastomosis is certainly no longer than that in which end-to-end suture is used, for the time that is lost in the closure of the divided ends in the former is more than compensated for by that which, in the latter, has to be spent in the ensuring of perfect accuracy of peritoneal apposition. The surgeon is also, I think, more disposed to free excision of a diseased segment of the gut when he is indifferent as to the question of securing an end-to-end approximation.

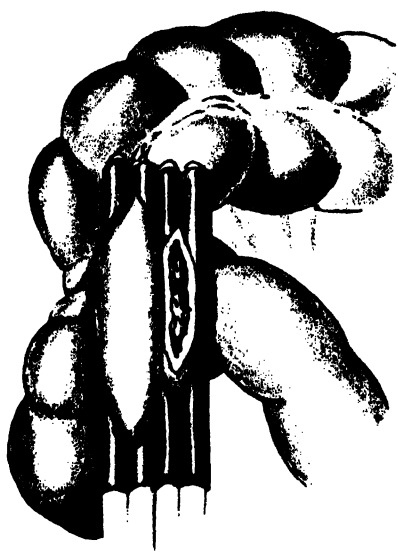


Fig. 177.—Resection of the cæcum. Anastomosis of the divided end of the ileum with the ascending colon.

The simplest and speediest method of dividing and closing the cut ends of the ileum and colon is as follows: The line of division is determined upon, and a powerful clamp—the compression forceps of Doyen—is applied, and as great a pressure as possible is made with it. On taking the clamp off it will be found that all the coats of the gut, with the exception of the serosa, have been crushed away. To the crushed part a single catgut ligature is applied and the bowel is divided beyond it. Around this cut end a purse-string suture is applied: it picks up the serous and muscular coats, and when tied, the catgut

ligature on the crushed stump is buried. The purse-string suture is then itself protected by a single line of continuous suture, so that perfect security of closure is ensured. The colon is dealt with in a similar manner.

In some instances an end-to-side anastomosis may seem desirable. The cut end of the colon is then closed in the same manner as before, but the open end of the ileum is implanted into a special opening made into the side of the large intestine and is there sutured. This method is one that is rarely necessary, and is certainly never to be chosen when a lateral approximation is possible. Kocher considers that an end-to-side anastomosis should be performed in those cases where there is great disparity in the sizes of the colon and ileum, the wide opening in the colon being securely closed and a special opening being made in the side of the bowel.

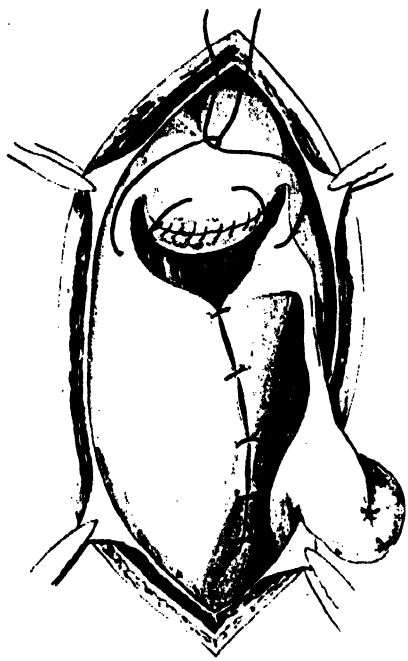


Fig. 178. —"Peritonisation" of the bare surface left after removal of the cæcum (after Guibé).

When the resection and anastomosis have been safely completed, the raw surface which has been exposed by the stripping up and removal of the ascending colon is covered in as far as possible. The neighbouring peritoneum in all directions is stripped up and its edges are then drawn together. To this most necessary procedure the French apply the term "peritonisation."

RESECTION OF THE LARGE INTESTINE.

(*a*) **For Growth.**—Excision of a portion of the large intestine is most frequently performed for growth. Malignant disease attacks the flexures of the colon, the hepatic flexure, the splenic flexure, and the end of the pelvic colon, more often than the intermediate portions: but any part of the bowel may be affected.

The mechanical difficulties in the performance of resection of the bowel near the flexures are sometimes considerable and may be insuperable. The growth is small and hard, and has contracted the very strongest adhesions to the posterior abdominal wall or to any adjacent structure in no meagre proportion of the cases. Owing to the gradual narrowing of the lumen of the gut, obstruction has been slowly produced. The obstruction is of the "chronic" type, with a distended and hypertrophied colon on the proximal side of the growth. An acute obstruction, long threatened, may at any moment, and without apparent cause, be precipitated. The distended bowel above the stricture shews signs of degeneration of the mucosa, and patches of ulceration may be found. In such circumstances, and in all cases where an acute obstruction has been present, some operation will have been previously performed,—a colostomy or typhlotomy, or ileosigmoidostomy,—for the purpose of affording relief to the overdistended bowel, and resection is undertaken later when the obstruction has passed away or when the intestinal regularity has been restored.

The typical resection is most easily carried out when the growth involves the transverse colon or the sigmoid flexure. These portions of the large intestine are more freely mobile and their peritoneal investment is more nearly complete. The operation now to be described applies to the excision of growths in one of these positions. The special points to be observed when the growth is situated elsewhere will receive mention later.

The abdomen is opened over the site of the tumour. An incision through the middle line or through the right or left rectus will give easy access to the transverse colon. An incision about two inches above Poupart's ligament, at its outer end, with splitting of the muscle-fibres, as in McBurney's operation for the removal of the appendix, will permit the sigmoid flexure to be withdrawn without difficulty. The incision in either case must be sufficiently free to permit of a perfect exposure of the growth of the gut on each side for a distance of three or four inches, and of any of those structures to which adhesions may have been formed. If, as not rarely happens, the omentum is puckered up over and around the growth, that portion of it which is adherent must be removed. The growth, when rendered quite freely movable, is withdrawn from the abdomen, and the two layers of swabs placed in position. The outer layer, first introduced, is large and remains unchanged throughout the operation; the inner, consisting of smaller swabs, is changed from time to time when soiled by blood or intestinal content. The mesocolon or the mesosigmoid is carefully examined for enlarged glands, and the limits of the parts to be removed accurately defined. The clamps are then applied. Two pairs, close together, are placed well beyond the proximal end of the growth, and two also beyond the distal end. They are applied obliquely, so that when the gut at each end is divided between the clamps, more of the bowel is removed from that side opposite the mesentery. The gut is now cut across above and below, and the divided ends to be united thoroughly cleansed with swabs and hot sterile salt solution.

The cut ends of the segment of bowel to be excised are carefully wrapped in gauze, so that there shall be no slightest soiling of the operation area. The mesentery is now dealt with in the following manner: A triangular portion is included between two cuts which extend from the mesenteric margin of the divided bowel and meet at a point about 1½ to

2 inches from the intestine. The wedge-shaped portion of mesentery so included is of sufficient size to ensure a complete removal of all infected glands. The removal must not be done in a niggardly manner, but due regard must be had to the integrity of the vascular supply of the bowel at the line of anastomosis. The position of the vessels must be borne constantly in mind; in not a few instances the vessels can be readily seen and felt. Any bleeding points in the divided edges of the mesentery are seized with pressure-forceps, which are left on until the suture of the intestine has been completed. The clamps are now placed side by side and the suture is applied in precisely the same manner as in end-to-end anastomosis in the small intestine. It may be that there is some disparity in the sizes of the ends of gut to be united. If so, a longitudinal incision in the smaller end, along a line most distant from the mesentery, or the making of an oblique section of the gut, will ensure an equal opening. The stitches are now introduced. That portion of the bowel at the mesenteric edge is first stitched, and very especial care is taken with the first few turns of the needle. The first stitch is seromuscular, and picks up the outer covering of the bowel about $\frac{1}{4}$ inch from the cut edge. The suture begins near the mesenteric attachment, and in the first two passages of the needle only the mesentery is pierced on each side. As the mesentery reaches the intestine its layers separate, leaving a triangular gap. It is the mesentery bounding the triangular gap which is picked up by the first turns of the needle. The suture is then continued, including the serous and muscular coats only (perhaps the submucous or a part of it also), until one-half the circumference of the bowel is united —until, that is to say, the part of the gut most distant from the mesentery is reached. The needle is then laid aside.

The inner suture is now introduced. This includes all the coats of the bowel and ensures two results—a perfect mechanical approximation of the divided ends of the bowel

and hæmostasis. It is not necessary to clip and to ligate any points in the cut edge of either end of the intestine. To introduce the stitch skilfully some practice is required. Owing to prolapse or retraction of the mucosa it may be difficult to pick up, on the needle-point, precisely that amount of intestine which is necessary. The stitch may at first be drawn over-tight; it is more likely, however, that it will not be drawn tight enough. I have found the best standard of the necessary degree of tightness that which results from a draw upon the thread from the last stitch of a degree sufficient to raise up, prominently, that part of the walls of the intestine into which the needle is next to pass. If the thread be drawn steadily and held firmly upwards, it raises the portion of bowel through which the needle last passed, and makes prominent that part which is about to be caught up in the needle.

It is the first two turns of this suture which are of chiefest importance. By them the gap at the junction of the mesentery and of the bowel is closed, and a perfect serous apposition ensured. As the two openings lie side by side, there are two triangular gaps—in the right and left divided ends of the intestine. The stitch is begun by being passed from the mucosa of the lumen of the bowel on the right, through all the wall of the bowel, and through that portion of the mesentery which has just separated from its fellow at the gap; from there the needle passes to the bowel on the left, penetrating all the coats there beginning with the separating layer of mesentery, and entering then into the lumen of the bowel; from here it pierces the mucosa about $\frac{1}{8}$ inch from the point of its last emergence through all the coats and through the other leaf of the mesentery; and, finally, it passes from the mesentery to the mucosa of the portion of intestine to the right, entering the lumen of this bowel through the mucosa about $\frac{1}{8}$ inch from its original point of entry; the suture is tied and the end left long. The suture is now

continued around the posterior half of the margins of the opening, embracing all the coats and being pulled fairly tight and even. No puckering of the gut need be feared. Each individual portion of the stitch must be separately tightened. If one loop be left slack, it cannot be tightened later without releasing all the stitch. The suture approximates first the posterior margins, and then, without change or interruption, is passed along the anterior margin until the end, left long at the first stitch, is reached, when the thread is knotted and cut short. The clamps are now removed from the intestine, as the ends are securely closed, in order to see if the suture-line bleeds at all. As a rule, the hæmostasis is perfect, but once and again a point will be found to bleed. A separate interrupted stitch is then passed to include this point and tightened. The arrest of the hæmorrhage being complete, the bowel is again gently washed, and the seromuscular stitch, laid aside for a time, is now restarted. The circuit is completed by carrying this suture along the anterior margins until the mesentery is reached. Two turns of the needle are then taken in the mesentery, and, finally, the needle is passed through the mesentery to the deeper (or posterior) side, where it meets the end originally left long. The two ends are tied and cut short.

A perfect apposition results. The weak point in the suture-line —the gap at the mesentery —is strengthened by both stitches, and a leakage is virtually impossible.

In suturing the large intestine I have recently used the Connell suture in place of the inner hæmostatic suture here described, and I have been very well pleased with the neatness and finish of the result. I have not relied wholly upon the single layer, as Connell himself has done, but have used, in addition, the outer seromuscular stitch. This adds something to one's sense of security even if it is not necessary. After the suture-line is complete a thorough washing with salt solution of the bowel is necessary, and the hands are well rinsed. The

swabs are then removed, and the bowel returned within the abdomen and the external wound closed in the usual manner.

Such are the details of the operations when the growth is in a part of the bowel that is quite freely movable. When any part of the colon other than the transverse colon and the sigmoid flexure is affected, the mechanical difficulties of the operation are increased, especially in patients who are not very thin. The adhesions which fix these portions of the bowel to the posterior abdominal wall are not seldom dense, tough, and with difficulty separable. But the difficulties can be overcome by persistent careful effort. The bowel affected must then be rendered sufficiently mobile to permit of its being drawn up into the wound, and, if possible, outside the abdomen. These cases will sometimes exercise all one's powers of patience, but in no case have I failed to get the bowel sufficiently free to permit of an end-to-end anastomosis.

The incision in all cases must be made over the growth, the position of which is made plain either by the presence of a tumour or by a previous exploration. This renders the operation as little difficult as possible.

The intestine being freed and isolated, the growth is excised and the ends are united in the manner already described. In some cases an end-to-end anastomosis may be impossible, though I have never personally encountered such a case. In these circumstances a closure of the two ends and a lateral anastomosis of two appropriate portions of the bowel become necessary. In a case of growth in the descending colon, for example, the transverse colon may be united to the sigmoid flexure. In many cases of this kind one is struck by the fact that, owing perhaps to dilatation and hypertrophy and "sagging" as the result of these, the transverse colon will easily reach the pelvis and may overlie the collapsed sigmoid flexure.

The application of a bobbin or a button is never necessary in any case of colon anastomosis, and is, indeed, most undesirable.

(*b*) **Resection of the Large Intestine for Growth Causing Intestinal Obstruction.**—In the great majority of cases of acute intestinal obstruction caused by growth in the large intestine an operation having for its sole purpose the relief of the over-distended bowel will be performed. The nature of this operation will depend partly upon the degree of the obstruction, but chiefly upon the position of the growth. Typhlotomy, colostomy, and ileosigmoidostomy are those most commonly practised. The resection of the growth is left until later. There are few rules so binding upon the surgeon as that which prohibits the resection of growths, and subsequent end-to-end anastomosis of the large intestine in cases of acute obstruction. The disparity in the size of the bowel above and that below the obstruction, the infection and ulceration of the mucosa on the proximal side, and the certainty of mischance when such unhealthy material is sutured—these are some of the reasons which deter the surgeon from attempting any such operation.

In many cases of growth in the large intestine that come to operation a tumour is already perceptible; in some the growth forms a "ring-stricture" and is with difficulty perceptible, in cases of obstruction, even when the abdomen has been opened. If a block in the large intestine has been diagnosed, but the exact site of it cannot be determined, an exploration in the middle line will be necessary. The position of the growth being discovered, the central opening is sutured and an incision made over the site of the growth. When the growth is exposed, it will be found that, as a rule, the tumour itself is small—of the size, very often, of a dinner napkin-ring—and feels solid. The finger invaginating the bowel either from above or from below discovers no passage through it. The gut above the obstruction is enormously distended; its walls are thick, reddened, and sodden in appearance, and the peritoneum may slither away under one's fingers in the gentlest handling, leaving a raw, oozing surface. During the manipulations this thickened gut may be seen to harden and contract in its ex-

aggerated effort to overcome the block to its outlet. The intestine below the growth is thin, pale, and collapsed from long disuse.

The most satisfactory solution of the question as to the best method of dealing with the growth in these conditions has been furnished by Mr. F. T. Paul. In an article in the "British Medical Journal," May 25, 1895, p. 1139, he describes an operation which seems to me, both in theory and in practice, to be the best possible operation. The following is the description there given:

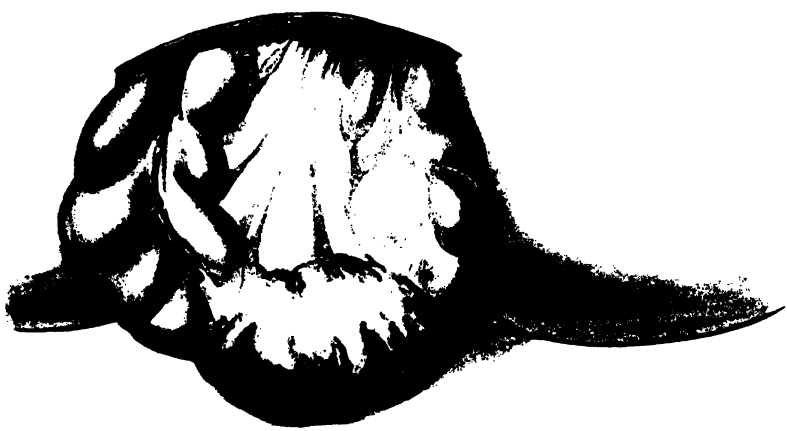


Fig. 179.—Colectomy during intestinal obstruction (Paul's operation). Tl growth is delivered through the abdominal wall.

"1. Explore first in the middle line unless the stricture has been located.

"2. Make a sufficiently free incision over the site of the tumour.

"3. Having cleared away any adhesions, ligate the mesentery with the help of an aneurysm needle, and divide it sufficiently to free the bowel well beyond the growth on each side.

"4. Let the loop of bowel containing the growth or stricture hang out of the abdomen, and sew together the mesentery and

the adjacent sides of the two ends, as shewn in Fig. 182. See that the stump of mesentery lies beneath the bowel, where, if deemed advisable, it can be drained by packing cyanide gauze down to it.

"5. Ligate tightly a glass intestinal drainage-tube into the bowel above and below the tumour and then cut away the affected part. Do not cut off first, or blood will be unnecessarily lost. Only the proximal tube is really necessary. The distal end may be closed or included in the proximal ligature.

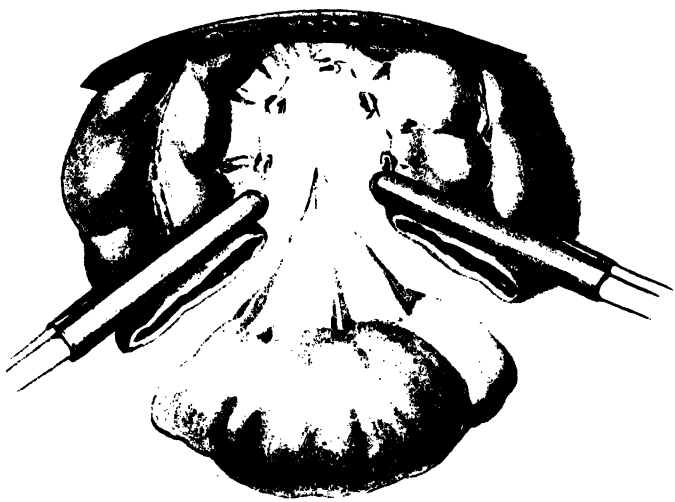


Fig. 180. -The bowel on each side of the growth is clamped, the mesentery ligated, and the growth removed.

"6. Close the ends of the wound with a few silkworm-gut sutures, passing through all the layers of the abdominal wall: no others are necessary.

"When the operation is performed in this way, all the vessels except those in the primary incision are tied before they are cut, and the intraperitoneal work is rendered quite bloodless.

"The second stage of the operation, that of breaking down the spur with an enterotome, should generally be undertaken about three weeks later. As soon as this has been satisfactorily accomplished the artificial anus is closed by separating the rosette of mucous membrane from the skin, turning it in, and bringing the freshened edges of the latter together over it."

A very similar method to this has been adopted for some years by Professor von Mikulicz. In a paper read before the American Surgical Association ("Boston Med. and Surg. Jour.," vol. i, 1903, p. 611) he gives a very brief description of the operation as practised by him, and makes the following remarks as to the selection of the operation:

"Statistics collected until now shew that the prevalent method of excision of the tumour and immediate suture of the intestine gives very bad results, the mortality varying between 30 and 50 per cent., and most patients succumbing to peritonitis. The cause of this phenomenon is found, I believe, mainly in the secondary changes which take place in the intestinal walls under the influence of carcinomatous stenosis. The gut is dilated, its nutrition impaired, and its muscular wall is insufficient: consequently after the operation we are apt to have complete atony of the intestine—the contents are arrested at the site of the suture, the suture yields, and peritonitis results. For this reason Bloch, as early as 1892, advocated operating in selected cases in two sittings. Allingham and E. Edmunds also have divided the operation in special cases. For a number of years I have invariably performed the operation in two sittings, and have found that the results were infinitely better than formerly. Of 24 cases operated on, only 4 died after the operation: but in none of these cases can the method of procedure be held responsible for the fatal termination. One patient died, eleven days after the operation, of embolism of the lung: another, after a week, of pneumonia; a third six weeks after the operation, of general carcinomatosis; and the fourth within two days, of peritonitis, caused by rupture of the carcinomatous gut during the

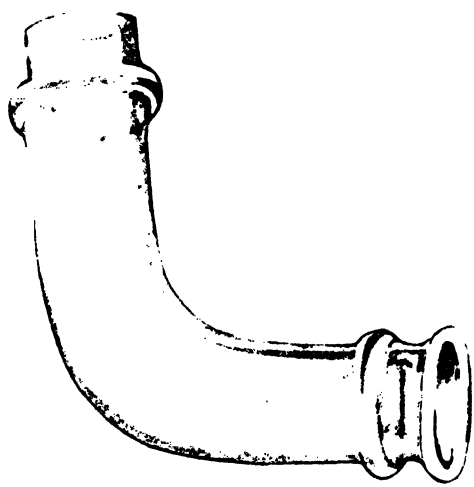


Fig. 181.—Paul's tube.

enucleation of the tumour, so that a large amount of infective intestinal contents reached the peritoneal cavity during the operation.

"As regards the technique of the two operations performed by myself, I should like to say the following: The primary incision, the enucleation of the tumour, the removal of the lymphatic glands, in short, the entire operation,—is performed exactly as when one operation only is done. If, now, the tumour

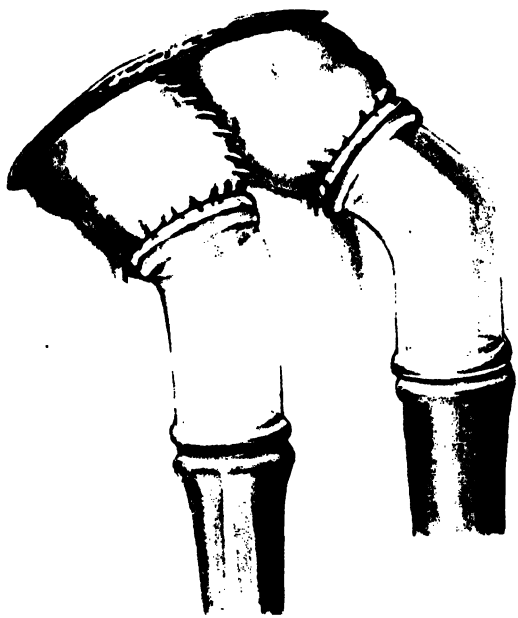


Fig. 182.—The limbs of the colon loop are stitched together, and into each divided end a Paul's tube is introduced.

has been free and completely enucleated, it is drawn out of the wound, the loop of gut is stitched to the parietal peritoneum with sutures including only the serous coat, and the abdominal wound is closed, leaving only room enough for the loop of the gut. Now only after the abdominal cavity is completely closed, the tumour is excised, and an artificial anus is established, which is closed in two or four weeks, according to the usual methods. The disadvantage of this process is that the patient is afflicted for a few weeks with an artificial anus,

but I believe that this is fully balanced by the advantage of greater safety."

In two recent cases in which I have followed this plan I have modified it very slightly. After the growth has been isolated, withdrawn from the abdomen, the mesentery ligated off, and the proximal and distal limbs of the affected loops stitched together, I have stitched the parietal peritoneum by a continuous suture around the two limbs, and have closed the abdominal wound on each side. The whole eventrated mass is then wrapped in a sterilised dressing, being first covered with a square of dental rubber sterilised by boiling. After twelve, eighteen, or twenty-four hours the growth is removed by dividing across the two limbs of the loop. As much time as possible is left between the first operation and the removal of the growth, and a hypodermic injection of $\frac{1}{4}$ or $\frac{1}{2}$ grain of morphine is given, to still the intestinal unrest. This method of delayed removal is, of course, possible only in those cases where the obstruction is not of the acutest—where, in fact, a delay of twenty-four hours adds no risk to the patient's life. The advantage of the delay is that it permits the complete sealing of the peritoneum, so that there is no risk of its infection by the discharge from the overloaded bowel. Moreover, I have found that when the bowel is divided in Paul's operation, it shews a tendency, at times a little disconcerting, to retract and to slip towards the abdomen. If the division of the bowel is left for twenty-four hours, and if it is made at least 1 inch from the skin, no difficulty of this kind will be encountered.

A somewhat similar plan is followed by Hartmann ("Bull. et Mém. Soc. de Chir.," November 8, 1904, p. 866), who writes:

"The tumour being freed from its connexions I draw it well outside the abdomen and fix the two ends of the loop of bowel to the parietal peritoneum by a continuous stitch. This is done without fear of infection if the gut has not been opened. I pack round the loop with iodoform gauze and then apply a compression forceps to the lower distal limb of the loop, and

apply in the groove left after their removal a single catgut ligature. This limb is crushed on a level with the skin. The same procedure is applied to the upper proximal limb, with this exception, that, instead of the line of crushing being on a level with the skin, it is at least two to three inches outside this. At this stage, therefore, the abdomen is completely closed: from it project two limbs of bowel, each securely closed. The lower limb is level with the skin, the upper is 2½ to 3 inches in length. In this latter a small button-hole incision is made, through which a tube is passed which drains the bowel. The tube is tied securely in and is left four to six days. It is then removed. The upper end retracts little by little, and finally makes only the smallest projection upon the skin. A fortnight later the abdomen is opened, the two ends of the bowel are crushed, ligated, and buried by suture; lateral enteroanastomosis is then performed, the artificial anus excised, and the abdomen closed."

The Choice of Operation in Cases of Malignant Disease of the Large Intestine.—From what has been said it will be readily understood that the choice of an operation in cases of carcinoma of the colon is by no means free from difficulties. There is no established practice: surgeons of equal eminence differ in their methods. Of one thing there can be no question, in cases of acute obstruction no attempt to resect the growth and to perform an immediate restitution of the canal is justifiable. The immediate indication in such circumstances is to afford relief; the surgeon must be content with that, and must never be persuaded into doing more than that. Relief to an acute obstruction may be afforded by opening the colon above the growth, by colotomy, typhlotomy, or by appendicostomy. The use of the appendix for such a purpose has never been adequately appreciated. Some three years ago, in a case of acute obstruction due to a growth in the hepatic flexure, I began an operation, intending to open the cæcum (typhlotomy). I found the appendix directly beneath my incision, and as it was of good size I drew it to

the wound, stitched it, about half an inch from its base, to the parietal peritoneum, and closed the rest of the incision. The greater part of the appendix then hung out of the wound. It was opened by cutting off the tip and passing upwards in the lumen a No. 10 catheter, which was tied in by an encircling ligature; the catheter was connected to a larger tube which led into a basin at the side of the bed. Perfect drainage of the overloaded intestine was thus established, and resection was performed about eight days later.

When the growth is situated in the cæcum, an acute obstruction is rarely caused. In almost every instance, therefore, a resection, with immediate suture of the divided ends, can be performed. As a rule, end-to-end suture is readily performed, but latterly I have met with good success by closing both ends of the bowel and performing a lateral anastomosis between the end of the ileum and the transverse colon. Especial care must be taken to effect a perfectly secure closure of the divided end of the ascending colon. In some circumstances a terminolateral (end-to-side) anastomosis may be performed, though I have no personal liking for this method.

When the growth lies in the transverse colon or in the sigmoid, resection and end-to-end anastomosis is the best operation; the results are extremely good.

When the growth lies in other parts of the colon than those mentioned, if obstruction is present, Paul's operation, or some of the modifications I have described above, should be performed; if obstruction is not present, resection and immediate end-to-end suture will prove a perfectly satisfactory operation.

Where an artificial anus has been made,—in the cæcum, for example,—a resection is undertaken at a later date; the anus may be allowed to remain in action until a sufficient time has elapsed to permit of secure healing of the line of anastomosis. In ten to fourteen days the artificial anus may be closed and the intestinal current restored.

STATISTICS OF CASES OF COLECTOMY FOR MALIGNANT DIS-

EASE.—I have collected the notes of 100 consecutive cases of colectomy for malignant disease from the recent literature. The following is an analysis of the cases:

The sex is stated in 97 cases; of these, 56 were males and 41 females. The ages ranged from an infant of nineteen months to a man and woman aged seventy-five and seventy-six respectively.

The greatest number occurred between the ages of thirty and sixty, as is shewn in the following table:

Decade.	Male.	Female.	Total.
0–10	(1 (Sex not stated.))		1
11–20	2	1	3
21–30	6	4	10
31–40	14	7	21
41–50	13	12	25
51–60	15	14	29
61–70	5	2	7
71–80	1	1	2
	56	41	98

Nature of Operation Performed.—In 68 cases the growth was resected as a primary operation. In 56 of these end-to-end suture was performed, with 16 deaths. In 2 end-to-end union was established and colotomy done at the same time. Both died. In 2 lateral implantation was practised with no deaths. In 7 union was effected by stitching up the free ends of the bowel and performing lateral anastomosis. Of these, 4 died. In 1 the growth was cut away and the ends of the bowel stitched into the wound, an artificial anus being left. This patient recovered. Thus, in 68 primary resections, there were 22 deaths, a mortality of 32.3 per cent.

In 12 cases *Paul's operation* was performed, the growth being fixed outside the abdomen at the primary operation and cut away a few days later, leaving an artificial anus to be dealt with. In one of these an ileosigmoidostomy was established at the primary operation. Of the 12 cases 1 died—a mortality of 8.3 per cent.

In 17 cases colotomy was done as a primary operation, the

growth being left to be dealt with later. In 12 of these the growth was removed and union effected between the free ends of the bowel at one operation. Three died (operation in two stages). In the remaining 5 the growth was excised by Paul's method. None of these died (operation in three stages). Thus, of the 17 cases of colotomy with secondary resection, 3 died—a mortality of 17.6 per cent.

In three cases ileocolostomy was done as the primary operation and followed by secondary excision. One died—a mortality of 33.3 per cent. The following table gives their statistics in brief:

100 CASES OF COLECTOMY.

Primary Excision.	Total.	Recovered.	Died.	Per cent. Died.
1. End-to-end	56	40	16	28.6
2. End-to-end and colotomy	2	0	2	100.0
3. Lateral implantation	2	2	0	0.0
4. Lateral anastomosis	7	3	4	57.1
5. Artificial anus	1	1	0	0.0
Total	68	46	22	32.3
Secondary Excision.				
Growth brought out and cut away later	11	10	1	9.1
Growth brought out and cut away later and ileosigmoidostomy	1	1	0	0 0
Total	12	11	1	8.3
Colotomy and Secondary Excision.				
Operation in two stages	12	9	3	25.0
Operation in three stages	5	5	0	0.0
Total	17	14	3	17.6
Ileocolostomy and secondary incision	3	2	1	33.3
Grand total	100	73	27	27.0

After-history.—Of the 73 cases which recovered from the operation an after-history is given in 64.

Six had died—1 of apoplexy at the end of a month, 1 of a recurrence in two months, 1 of typhus fever in nine months, 2 of recurrences at the end of a year, and 1 of an acute chest

trouble four years after operation. Thus of the 6 deaths only 3 were attributed to recurrence. Two others had recurrences—1 at the end of two months, the other in six months. All the rest were well when reported and without recurrence, though in many cases the report was made only a few months after operation.

1	reported	well	at	end	of	some	months.
7	"	"	"	"		2	"
3	"	"	"	"		3	"
1	"	"	"	"		4	"
3	"	"	"	"		5	"
2	"	"	"	"		6	"
3	"	"	"	"		7	"
1	"	"	"	"		8	"
3	"	"	"	"		9	"
1	"	"	"	"		10	"
7	"	"	"	"		1	year.
4	"	"	"	"		1½	years.
5	"	"	"	"		2	"
6	"	"	"	"		2½	"
4	"	"	"	"		3	"
2	"	"	"	"		4	"
1	"	"	"	"		5	"
2	"	"	"	"		7	"
56							

The two cases reported well at the end of seven years are those of Homer Gage and Hochenegg. They were a man and woman aged seventy-five and seventy-six respectively when operated upon.

CHAPTER XXVI.

RUPTURE OF THE INTESTINE.

ANY surgeon whose experience of hospital work is extensive will have realised the great difficulty that almost always exists in discriminating in the early stages between those cases of abdominal injury which are trivial and those in which a laceration of the intestine has occurred. If there is a wound of the abdominal parietes, the surgeon's course is clear; it is his duty in all cases to open up the wound, and, if need be, to investigate the conditions within the peritoneal cavity. If, however, there is no sign of external injury, the necessity for operation must be determined by the signs and symptoms which are present. In such cases "it becomes necessary," as Dr. Le Conte says, "to make a most careful examination of both the subjective and the objective symptoms presented by the patient, to separate the trivial from the important points, and with our best judgment to sum up the evidence for or against operative procedure." The accurate observation and instant recording of symptoms, and of their variation from hour to hour, are needed to enable the surgeon to form his opinion correctly. I propose to discuss the relative values and significance of the chief signs and symptoms and to indicate the steps by which an accurate decision may be formed.

The character of the injury sustained should be determined as closely as is possible. As a rule, the damaging force is one of two kinds: it is either a blow from some small or sharp object, the force being considerable and applied only to a small area of the abdominal wall; or it is a force diffusely applied over the greater part or the whole of the abdomen. Of the former, the most exemplary instances occur when the abdomen is struck by a small, rapidly moving object—the fist, a horse's hoof, or

a boot; or when the patient, while moving rapidly, strikes the abdomen against the sharp corner of a table. Of the latter, the most common instance occurs when a patient is run over by the wheel of a cart or train, or is squeezed between the buffers in a railway accident. The injury when the force is of the former kind is found to be a rupture, by crushing, of the intestine, beneath the point struck. When the force is diffused, a rupture occurs, as a rule, at one of the fixed points of the bowel—at the duodenojejunal flexure or at the ileocæcal junction—or the mesentery is torn.

The injury to the intestine is of different kinds. The bowel may be crushed between the offending object and the spinal column or pelvic wall; it may be burst when full of its normal contents; it may be torn away from one of its fixed points; it may be damaged, though not completely ruptured, by the blow, and sloughing and gangrene at the injured area may lead to secondary perforation, or the mesentery with its vessels may be so injured that gangrene of the gut supplied from these vessels will in time result. The injury may be limited to the mucous coat or to the peritoneal coat, or it may, and most frequently does, involve the whole thickness of the wall.

Homer Gage, in collecting the records of 85 cases operated upon between 1887 and 1902, found that in 75 the injury was due to direct violence, and in 32 of these was due to a kick by a horse or by man. In 19 it was caused by a fall, and in 6 by a piece of wood thrown from a circular saw. In 9 it was the result of a crushing force, and in 1 the cause is not stated. From this it is clear that there is a greater likelihood of damage when there is a high velocity of the striking object and when the area struck is small.

In Makins' series of 21 cases occurring at St. Thomas's Hospital between 1889 and 1898, 6 were the result of kicks by horses, 5 patients were run over, 4 fell against resisting objects, 2 patients were caught between buffers, 1 was struck by the end of a plank on a sawing-machine, 1 was pinned by

the pole of a van against the wall, 1 was struck by a falling box, 1 was caught and rolled between two passing railway trucks.

LOCATION OF THE LESION.

In 79 of the 85 cases collected by Homer Gage the injury was located as follows:

Duodenum	10
Jejunum	20
Ileum	43
Large intestine	6

These figures agree with those given by other writers. It is an undoubted fact that rupture is more common the greater the distance from the duodenojejunal flexure.

An examination of the abdomen in these cases will frequently shew, especially after the lapse of a few days, that the point of impact is indicated by a bruise. In a great majority of cases this will be found to be below the umbilicus. In the 9 cases of injury to the small intestine in Makins' series in which the position of the bruise was ascertained, it was found to be below the umbilicus in 8. In the cases of injury to the large intestine this fact was even more marked. There were 5 cases of injury to the large intestine: in 1 the junction between the cæcum and ascending colon was torn; in 1 the lower end of the ascending colon; in 2 the transverse colon (in both of these the colon was U shaped and hung down below the umbilicus), and in 1 the sigmoid. The part of the abdomen below the umbilicus may, therefore, be quite appropriately named the "*dangerous area.*"

THE CHARACTER OF THE LESION.

As a general rule, there is only one rent in the intestine. In 9 cases in Homer Gage's series of 85 cases there was more than one tear. In one case recorded by Kopfstein, six rents were found and were closed successfully. In some instances, especially in those cases where the injury is due to the kick

of a horse, two ruptures may be found at a distance of three or four inches from each other. It is suggested that the injuries are then due to the impact of the two ends of the hoof. In one case which I saw a piece about 5 inches in length was cut completely out of the intestine. The rent may be small, or it may be large, longitudinal or transverse, ragged or straight—it may, in fact, be of any shape or size or run in any direction. Injury to the mesentery is found in about 10 per cent. of the cases.

THE DIAGNOSIS OF INTESTINAL RUPTURE.

The importance of an early diagnosis of rupture of the intestine cannot be exaggerated, and delay of an hour in any case may mean—does, in fact, mean—that the chances of recovery by operation are thereby lessened. A laceration of the intestine is more likely to involve the ileum than the jejunum. The upper part of the intestine, as is well known, contains fewer and less virulent organisms than the lower part, and therefore the lower down in the intestine the wound lies, the greater will be the damage done to the peritoneum by the escape of the contents.

The patient when first seen will probably be suffering from shock and its attendant symptoms. In this there is nothing characteristic, for an equal degree of shock may be produced simply by a severe bruising of the abdominal wall. The pulse will, at the first, be small and thready. In doubtful cases the pulse must be counted by a reliable observer *and recorded* every hour. A pulse which increases steadily in frequency should arouse suspicion, more especially if the rate of respiration is also increasing and the temperature, after a rapid rise, following the subsidence of the early collapse, begins to fall. As the shock is passing away the patient will vomit. If the vomiting should continue, the outlook is most serious. Persistent vomiting is the most characteristic symptom, and is present, almost without exception, in cases of in-

testinal rupture. This has been our experience at the Leeds Infirmary, and the same observation has been made by Trendelenburg and others. The abdomen may be tender from the first. Owing to the injury done to the anterior abdominal wall, the skin may be sensitive to pressure and the muscles may be rigid. In cases of rupture of the intestine there is very often the most absolute rigidity of the abdominal wall. The muscles are tense, and will not yield to the gentlest or to the firmest pressure. Even when morphine has been given, the muscular rigidity does not disappear; indeed, it hardly lessens to any perceptible degree. Gentle kneading of the abdominal wall with the open hand does not permit a deeper examination of the abdomen. The rigidity increases steadily from the time of injury, and it is always unyielding. A definitely localised tenderness is often found when there is a rupture of the kidney or of the bladder, one or other side or the hypogastrium being tender and resistant when the rest of the abdomen is supple. It is the universal and unalterable rigidity that is significant.

The abdomen is not distended at the first, but within a few hours a little fullness is often noticed. If the distension increases rapidly, it is a sign of great gravity. Free fluid may be found in the peritoneum; it is due—(*a*) to blood which has escaped from a rent in the mesentery or in the bowel-wall; (*b*) to escape of thin fluid contents from the intestine; (*c*) to the rapid outpouring of serous fluid from the peritoneum. If fluid be present, it is an evidence decidedly in favour of operation.

The general appearance of the patient almost always gives one the impression that his condition is serious. He looks anxious, his features are drawn, his face is pale, and the skin is sweating. Dr. Le Conte, who considers the facial expression the most positive of all the symptoms of severe abdominal injury, writes: "The abdominal facies consists of a peculiar drawing of the lines and deepening of the furrows of the face, which give an anxious, careworn, and painful expression to

the countenance, while the eyes are questioning and anxious and search the faces of the people about." He adds: "I cannot recall ever having noted it as present in a case which failed to shew a serious lesion."

To sum up, one may say that when a patient has sustained such an injury to the abdomen as is likely to produce a serious lesion—if the abdomen soon becomes rigid and tender; if the rigidity steadily increases and affects the whole abdominal wall; if the vomiting is repeated at short intervals; if the patient, by his facial appearance, conveys the impression of serious illness—then an exploratory operation is not only justified, but is imperative. A reckless opening of the abdomen in all cases where any severe injury has been sustained is not to be condoned. A discrimination of the serious cases —of the cases that can be cured only by operation—from those which will recover unaided can be made with very few exceptions by attention to the points which have been mentioned.

All the signs mentioned above may not be present simultaneously. Reliance must then be chiefly placed upon the onset and continuance of vomiting after the period of shock is over, and upon a continuous increase in the pulse-rate. These two signs together fully justify an exploration. The greatest difficulty in diagnosis occurs in cases in which the injury is inflicted upon the highest part of the jejunum in patients who have not partaken of food for many hours. Dr. Le Conte relates the case of a man who was struck a glancing blow on the abdomen by a rolling steel ingot weighing two tons. This happened at 8.30 A. M., and the man had not partaken of food since the previous evening. Fifteen hours later he presented no sign of intestinal injury. During the next six hours symptoms of perforation rapidly appeared: pulse and respiration rapidly increased; the temperature fell below normal; vomiting began; tympany appeared, with marked tenderness in the region of the umbilicus, and the expression of the face was anxious and

drawn. Operation shewed that the first part of the jejunum was completely torn across, the laceration extending for 2½ inches into the mesentery; in another place there was a 2½-inch tear in the mesentery which had extended to the small gut, and about one foot of the intestine shewed commencing gangrene.

Dr. F. B. Lund ("Boston Med. and Surg. Journal," vol. cliii, 1905, p. 603), in recording 19 cases of rupture of the intestine, makes the following remarks upon the question of diagnosis:

"The symptoms which at first ensue upon a rupture may be, and often are, so slight that the surgeon feels a false sense of security. He judges that probably no harm has been done, and the patient is left until a general peritonitis is developed before he is operated upon. It is for this reason, it seems to me, that a knowledge of the common etiology of these cases is important.

"In cases which have been subject to injuries of this sort an exploratory laparotomy should be done without waiting for an absolutely certain diagnosis, which also means the almost certain death of the patient. After these blows upon the abdomen by a board from a circular saw, or by a horse's hoof, the patient is very often faint, sometimes vomits, and then the rapidity with which the symptoms come on depends upon the rapidity with which the intestinal contents are poured into the abdomen. If the rupture is a small one, as not infrequently happens, it may be nearly closed by protruding mucous membrane. Here the pain, tenderness, muscular spasm, and temperature indicative of peritonitis, may develop gradually as in the case of general peritonitis, in which the patient went to work the day after the fatal accident happened to him. Or, if the rupture is a large one, the rapid extravasation of intestinal contents brings into immediate evidence the symptoms of general peritonitis and leads to immediate operation.

"The peritonitis must be quite general before the patient looks badly. The pain, tenderness, muscular spasm, slight rise in temperature, and the fact that the patient is getting worse, should be sufficient for immediate operation without waiting for the facies which practically always indicates that peritoneal sepsis has progressed to such an extent that no operation will control it."

Delay in the onset of symptoms may be due to a *secondary perforation* of the bowel. The damage at the time of the accident concerns the mesentery, or bruises, but does not lacerate, the intestine. Sloughing of the bowel occurs twelve to forty-eight hours later, and is announced by the sudden onset of the symptoms of perforation already described.

In Angerer's series of 160 cases the 10 cases which recovered after the formation of fæcal fistulæ were undoubtedly exemplary instances of secondary rupture.

Dr. Arthur L. Fisk records ("Annals of Surgery," vol. ii, 1900, p. 626) the case of a man who, on October 29, 1900, while crossing the street, was run over by a hose-carriage, one of the wheels passing diagonally across his right loin. He was immediately taken to the Trinity Hospital in a condition of shock, with a subnormal temperature. Examination shewed a large swelling in the left side of the abdomen, especially in the lumbar region, which was regarded as a hæmatoma. There was no blood in the urine, and when his bowels moved, the stool was also free from blood. The abdominal muscles on the left side were distinctly rigid.

On November 4 there was fluctuation in the mass referred to, and the man began to have some fever. The mass was thereupon incised in the loin, and a large quantity of pus evacuated; the pus had a faint fæcal odour. Two days later there was a discharge of fæces through the wound, and for two weeks all the fæcal contents of the bowel were evacuated in this way. On November 21 there was a severe hæmorrhage from the sinus; a second on the twenty-fifth, and a third on the thirtieth. From that time on the sinus passed directly into the ascending colon.

A. L. Bonanome ("Brit. Med. Jour.," Epitome of Current Literature, August 27, 1904, p. 30) reports a case of rupture of the small intestine by indirect violence. The patient, a man thirty-seven years of age, jumped to the ground from a height of about two feet, and came down heavily on his heels. He immediately felt acute pain in the hypogastrium, accompanied,

for a very short time, by slight mental confusion and followed by vomiting. Feeling unable to continue his work, he walked home, about two miles, and then walked to the hospital, where he was seen an hour and a half after the accident. Inspection of the abdomen revealed nothing. Palpation caused pain in the hypogastrium, and especially in the abdominal muscles. The recti muscles were contracted a little. No pain was caused by palpation of the epigastrium, the hypochondrium, and the flanks. In the iliac fossæ it was possible to press back the abdominal wall so as to feel the bones. Voluntary contraction of the abdominal muscles caused increased hypogastric pain. The liver and spleen did not pass the costal arch, and their areas of dulness on percussion were normal. No free fluid could be made out in the abdominal cavity; 150 c.c. of normal urine were removed from the bladder by catheter. The pulse was full and regular—80; respirations, 22; temperature, 36.9° C. The face was a little pale. He remained in the hospital, and ice was applied to the abdomen. In the evening the temperature was 37.5° C., pulse 85, respirations 24. The abdomen was soft except at the hypogastrium. There was no meteorism. Flatus and urine had been passed, but no fæces. The patient had anorexia, but not thirst. The next morning he was in rather better condition after several hours' sleep. On the afternoon of that day, beginning twenty-seven hours after the accident, the appearance of the case completely changed. The pain, the muscular contraction in the hypogastric region, and the meteorism were increased. The area of hepatic dulness disappeared. The face indicated distress. The patient, who had all along stated that, but for the pain, he felt well, now complained of illness. Temperature, 38° C.; pulse, 90; respirations, 26. A diagnosis of peritonitis was now made, and an abdominal section decided upon. Gas and liquid were found in the peritoneal cavity. An oval opening into the small intestine was found on the convex side of the intestine at a point diametrically opposite to the insertion of the mesentery. The long diameter of this aperture,

about 4 mm. in length, lay in the direction of the course of the intestine. The edges were cleanly cut and not ecchymosed. The mucous membrane protruded a little through the wound. No appearance was found of other recent or old-standing disease or injury of the intestine. The wound was closed with two planes of Lembert sutures and the abdomen cleansed and drained. The patient died ninety-nine hours after the accident. At the autopsy the opening in the intestine was found to be about nine feet from the ileocæcal valve. The sutured portion was healthy, and the whole intestinal mucosa presented a normal appearance. No foreign body was found in the intestine or in the peritoneal cavity. The cause of death was general peritoneal infection.

OPERATION.

When it has been decided to operate, all preparations must be made before the patient is anæsthetised, for speed is one of the essentials of success. An abundance of hot saline solution will be needed for the purpose of irrigation. Operation should be deferred until the first shock has passed off. The incision should be made in the middle line, and should be of ample length. Many authorities advise that the incision should be made at the point where the blow was inflicted, but there are no advantages in so doing. All parts of the intestinal canal can readily be examined through a median incision; an incision through the area of impact will often open up an extensively bruised area, large collections of blood in the abdominal wall will be found, and septic changes therein are prone to follow. The incision is at least four inches in length, and may, with advantage, be six inches or even more in stout or muscular patients. As soon as the peritoneum is incised there will be an escape of blood-stained, thin, fæcal fluid, or of fluid which is turbid and has a fæcal odour. If the bleeding is at all abundant, it is better to turn the intestine out at once and to make a careful search for a rent or rents in the mesentery. If there be little

or no bleeding, then the intestine is examined methodically. It is better to begin at the cæcum and to work upwards along the small intestine, the bowel, as well as the mesentery, being very minutely examined. If a rent be discovered, the part of the bowel which it involves is wrapped in a large moist swab and held by the assistant, while the search is continued. In approximately 10 per cent. of cases there are more ruptures than one. If no other points of injury are discovered, the greater part of the intestine is returned within the abdomen, and the injured loop is packed around with moist sterile compresses. The evisceration undoubtedly simplifies the search for the damaged spots. If carried out speedily, it is not provocative of harm. The intestine, while outside the abdomen, should be carefully surrounded by hot compresses, and must be returned within the abdomen at the earliest possible moment.

Trixier has shewn that the shock of evisceration is directly in proportion to the condition of the peritoneum and the length of exposure. If the peritoneum be healthy and the exposure brief, no harm is done. In all cases there is a "period of indifference" during which no shock is experienced. This period is shortened when the peritoneum is inflamed. The search for a damaged spot is very much simplified by observing whether there is any deposit of plastic lymph upon the gut. Lymph is very rapidly poured out, and may be found in abundance within six hours of the receipt of the injury. It is always found in greater quantity at and near the perforation.

The rent in the bowel is repaired in a manner best suited to the condition of the injury. If a small transverse or longitudinal tear be found, it may be closed at once by a double layer of continuous sutures, the one including all the coats, the other picking up only the serous and muscular coats. If the portion of the bowel most distant from the mesentery is torn by an irregular rent, a part of the wall of the gut may be excised. The mesenteric portion of the intestine is left intact, and an angular union is effected, the two portions of the bowel being, as it

were, bent upon the bridge of bowel which remains at the mesentery. This is the "elbow" anastomosis of Jeannel.

If there are two or more injuries close together, or if there be only one rent with a considerable amount of bruising of the parts around, either mesentery or intestine or both, an excision of the damaged area should be performed. On rare occasions a double or even triple resection may be necessary.

If there should be a rent in the mesentery completely dividing the vessels therein, the bowel supplied by these vessels must be resected, for gangrene is certain to follow. A small tear in the mesentery may necessitate a large resection of the bowel, for, as has been already pointed out, one inch of the mesentery near its posterior attachment may contain the blood-supply of two feet or more of the intestine.

In certain cases none of these measures may be possible. The patient may be desperately ill, and able to bear only the least of all surgical manipulations. In such circumstances the rent in the intestine may be sutured to the abdominal wall, the repair of the wound being left for a subsequent operation. This method—the establishing of an artificial anus—was, at one time, the method advocated by all authorities, but in recent years it has been recognised that instant repair of the damaged bowel should be performed whenever possible.

After the intestinal wounds have been securely closed, it is necessary to deal with the mesentery. Any small bleeding points near the intestine may be ligated, and a tear which does not involve any vessels may be closed by suture. In some cases the two layers of the mesentery may enclose a diffuse blood-clot; this may, as a rule, be ignored, provided that the vascular supply of the attached bowel be unimpeded. A very small vessel may give rise to a very large hæmatoma. Search for a bleeding vessel in such a bruised area will be fruitless, and only provocative of further harm.

When all the measures of repair are accomplished, the peritoneal cavity is cleansed. Free washing-out with hot and

sterile salt solution is always necessary. The lavage should be free, and all parts of the cavity should receive attention. The irrigation is best carried out by means of a funnel to which is attached about a yard of large, soft, India-rubber drainage-tube. The funnel is kept constantly filled by the nurse, and the soft tube is readily moved from place to place within the abdomen. If peritonitis has been set up by the irritant fæcal fluids, drainage is always necessary. If, however, the case has been operated upon early, the abdomen may be closed at once.

The application of omental grafts or flaps may, at times, be of great advantage. Parts of the omentum, if bruised, may have to be removed.

RUPTURE OF THE COLON.

Rupture of the large intestine occurred five times in Makins' series of 21 cases of intestinal injury, occurring at St. Thomas's Hospital in a period of ten years. The injury involved the cæcum once, the lower part of the ascending colon once, the transverse colon twice, the sigmoid flexure once. In all these cases the point struck in the abdominal wall was below the umbilicus. The general symptoms of rupture of the colon are indistinguishable from those of rupture of the small intestine. One sign alone is characteristic of lesions of those portions of the bowel which are not wholly covered by peritoneum (parts of the duodenum and the ascending and descending colon)—that is, emphysema. If there are the usual symptoms of intestinal injury and emphysema in the right flank, a diagnosis of rupture of the ascending colon or of the duodenum may safely be made. Emphysema spreading from the descending colon is noticed first in the left flank. In one case of ruptured duodenum, in Makins' series, the emphysema was first observed in the left flank. In a case of rupture of the ascending colon which involved both the serous and the unprotected parts emphysema was present, but was discovered only at the operation; it had not passed the limits of the ascending colon.

PROGNOSIS AND RESULTS OF TREATMENT.

It may be taken as an unquestionable fact that complete rupture of the intestine, unless treated by operation, is invariably fatal. It has been stated, upon utterly insufficient evidence, that patients have recovered under expectant treatment. A close enquiry into all such cases shews, as might have been anticipated, that there is no warrant for any diagnosis of rupture. All the cases collected by Curtis, 116 in number, were fatal. All the cases in Homer Gage's series, 45 in number, which were not submitted to operation, died. Spontaneous recovery after a complete primary rupture of the intestine is not only improbable—it is incomprehensible.

Angerer ("Congress of German Surgeons," April, 1900) collected the records of 160 cases of rupture of the intestine treated expectantly: 149 died and 11 recovered. Of the 11, 10 developed fæcal fistulæ. The probability is that these were examples of secondary rupture, where adhesions had surrounded the wounded bowel and had sequestrated the part, which gave way later.

In operation lies the only hope of successful treatment. The first laparotomy for rupture of the intestine was performed by Bouilly in 1883. The first successful case was operated upon by Croft in 1889. The following are the notes of this classical case ("Clin. Soc. Trans.," vol. xxiii, p. 141):

"Charles A., aged fourteen, admitted into St. Thomas's Hospital, under Mr. Croft's care, on May 21, 1889, at 10.30 P.M.

"The boy had been kicked in the abdomen by a horse, about half-past seven in the evening. He fell when struck and became 'unconscious,' and was carried to his home in the same street and put to bed. He had taken his tea at half-past four, and he passed water about that time. As he was in pain, his friends gave him some 'senna' to act on the bowels. This he fortunately vomited. As his pains increased he was brought to the hospital. On the way there he vomited twice, and in the waiting room he brought up a little light-coloured fluid which was said to be streaked with blood. A catheter was passed in

the admission room, and about eight ounces of normal urine was drawn off. When admitted, it was not thought that he was suffering from shock. It was observed, however, by the nurse, that he doubled up his knees and laid himself on his side. He had been kicked below the umbilicus, and the lower part of the belly was tender to the touch. Ice was applied to the abdomen. Morphine was administered hypodermically. Fluids and solids by the mouth were forbidden. The temperature taken after admission was 99.2°, and his pulse was steady at 80. During the night the temperature rose to 103.6°.

"On the following morning, May 22, at 9.45, Mr. Croft was called to see the boy, and found his expression anxious, the lips dry, temperature 103°, pulse quick, and tongue furred. The legs were drawn up, the abdominal wall flat, rigid, and very tender. The muscular resistance was very marked. The pain was chiefly below the umbilicus. There was slight dulness in the left loin, none in the right, and none over the bladder. He had not been sick since he had come into the ward, and he had not been delirious.

"The diagnosis was in favour of ruptured intestine and acute peritonitis. Exploration of the abdomen by median laparotomy was immediately determined upon and carried out.

"The patient was kept under ether, the operation lasting an hour and three-quarters. Mr. H. B. Robinson rendered very valuable assistance.

"On dividing the linea alba an œdematous condition of the subperitoneal tissue was observed. As soon as the peritoneal cavity was opened a faint fæcal odour was observed. When the omentum was drawn aside, about an ounce and a half of turbid, dirty-brown fluid escaped, with a distinctly fæcal odour; its under surface was adherent to some coils of intestine, and was coated with exudation and the same dirty-brown fluid. The coils of bowel were matted together and more or less stained. On breaking through these adhesions and separating the coils on the right side, about two inches below the umbilicus, the region of chief injury became more evident. A small rupture was found on the under surface of the ileum, measuring about three-eighths of an inch in diameter. This lesion was in the centre of a small areola of ecchymosed and inflamed tissue. On the opposite wall of the gut there was another ecchymosed spot, correspond-

ing with the first lesion. After cleansing and examining this portion of the bowel Mr. Croft determined to resect it, as he deemed it unsafe to return the contused as well as the ruptured pieces.

"Makins' forceps were applied below the spot at which the incision was to be made, and Mr. Robinson took charge of the upper portion. A V-shaped segment of the gut was cut out with scissors and snipped from its mesenteric attachment. Immediately after excision the mesenteric wound appeared to be not more than three-eighths of an inch in width.

"When bleeding had been arrested, the mesenteric wound was carefully closed from side to side by eight sutures, passed after Lembert's manner, four above and four below. The cut ends of the intestine were next carefully adjusted, and opposite the attachment of the mesentery sutures were passed, so as to draw together the muscular coats, applying these coats *dos à dos*. Five sutures were needed for this. In bringing together the rest of the bowel Lembert's sutures were employed, about twenty being inserted. Extra sutures were put in where they seemed to be indicated, bringing up the total to over forty.

"As the piece of omentum opposite the injury was the reverse of pure, it was thought best to cut it right away. It was, therefore, ligated and excised.

"After this the peritoneal cavity was carefully purified with hot boracic solution, about 20 per cent. in strength, and the toilet of the peritoneum was completed. The external wound was closed by silk sutures. No drain was put into the peritoneal cavity. Antiseptic precautions were observed throughout. The operation lasted an hour and three-quarters."

The publication of this remarkable case naturally attracted a great deal of attention, and it soon became recognised that the only treatment likely to give the patient a chance of life lay in operation. Siegel has collected in all 376 cases submitted to operation. The mortality was 51.6 per cent. An analysis of the cases with reference to the time of operation gave the following result:

Cases operated upon within the first 4 hours had a mortality equal to.....15.2 per cent.

Cases operated upon within the first 5–8 hours had a mortality equal to	44.4 per cent.
Cases operated upon within the first 9–12 hours had a mortality equal to	63.6 "
Cases operated upon later than 12 hours had a mortality equal to	70.0 "

Several other small series of cases have been collected by Gage, Eisendrath, Petry, Kirstein, and others, but Siegel's list probably includes all cases recorded up to the time his paper was published. One has, of course, to discount such an estimate, for successes are more likely to be published than failures.

At the Leeds Infirmary since 1898 there have been 17 cases of ruptured intestine treated by operation. Of these, only 3 recovered. In all the cases save 2 over twelve hours had elapsed from the time of the injury. In Makins' series of 21 cases operated upon at St. Thomas's Hospital in ten years—1889 to 1898—there were 3 recoveries.

The following are the records of the 3 successful cases in the Leeds Infirmary:

CASE 1.—E. H. L., a boy aged six, was admitted to the Leeds General Infirmary, September 9, 1899. The patient had sustained an abdominal injury which caused collapse and gave rise to the signs of increasing fluid in the peritoneal cavity. Without entering into details, it may be said that the case clearly demanded surgical intervention. The following operation was performed:

Operation.—An incision, 5 inches in length, was made to the right of the middle line, extending from about 1 inch below the ensiform cartilage downwards. On opening the abdomen there was an escape of blood, and blood was seen lying everywhere among the intestinal coils. A rapid search soon revealed the fact that there was a complete rupture of the intestine at the duodenojejunal flexure. The jejunum appeared to have been torn out from the duodenum in such manner that the divided end of the duodenum was beneath the peritoneal level, and was ragged and irregular. The jejunum in its upper 4½ inches was torn away from its mesentery; this portion was removed. An end-to-end approximation was clearly impossible, as the cut duodenum was inaccessible. The duodenum was, therefore,

closed as securely as possible with a continuous catgut stitch, and the peritoneum around it sutured over this stitch. In order to ensure a complete closure the upper part of the mesentery which had been torn away from the jejunum was stitched as a sort of lid over the obliterated end of the duodenum. The jejunum was implanted in the anterior wall of the stomach with the aid of a Murphy button. After doing this it was my intention to make an anastomosis between the lower portion of the duodenal loop and the jejunum so as efficiently to drain the former, but the child seemed on the verge of death, and I had to complete the operation as speedily as possible. Stimulants, in the form of saline infusion, strychnine, and a hot-water enema, were given during the operation, and one minim of strychnine was given every hour for the first twelve hours. The patient gradually rallied and made a good recovery.

After-history.—After the first ten days we had a skiagraph taken, and three were subsequently taken. On each occasion the button shewed a different position, and we were inclined to accept this as an indication that it was passing along the intestinal canal. The patient gained weight, ate ordinary diet, and was quite well, and his condition was in every respect satisfactory. One untoward incident alone was observed, and that was a copious attack of vomiting, which we ascribed to a pork pie injudiciously given by a friend on the visiting day. The question of a second operation, the performance of an anastomosis between the duodenal loop and the jejunum, was frequently discussed, but the condition of the child was so satisfactory that we were unwilling to interfere. The stools were examined and pronounced in appearance and constitution normal.

Perforation.—On the one hundred and fourth day after operation the patient was suddenly seized with acute and overwhelming abdominal pain, and I was urgently summoned. I found him pale, pulseless, and utterly collapsed. He died an hour subsequently.

Postmortem Examination.—A perforation of the duodenum at the lowest point of the loop was found, the perforation being due to the Murphy button, which lay in the ulcer its pressure had produced.

CASE 2.—Under the care of Mr. Lawford Knaggs.

History.—R. L., aged thirteen, was swinging on a rope fixed

to two gate-posts when they collapsed, and a portion of a wall fell upon her, striking the pelvis and abdomen. The accident occurred on April 17, 1900, at 2.30 P. M.

Condition on Admission.—When admitted she was suffering from Colles's fracture of the right wrist, some hæmorrhage from the vagina, and a contusion of the left hip. The next day she complained of pain in the body, and at midnight I was sent for. The pain had been getting worse during the day, and now the abdominal wall was rigid and there was great tenderness over the lower part. Below the iliac spines the resonance was impaired and there was a doubtful thrill. The urine passed had been free from blood, and the bowels had not been open since admission. The pulse had risen from 100 to 120. The cause of the peritonitis was suspected to be perforation of a hollow viscus, possibly the bladder.

Operation.—At 2.30 A.M. on April 19, or thirty-six hours after the injury, median laparotomy was performed. Extravasated blood was found in the subperitoneal tissues. On opening the peritoneum pus escaped, but no gas. The intestinal coils were found matted together with yellow lymph, and very offensive pus lay between them. This was wiped away gradually as the coils were separated towards the pelvis. At last a portion of bowel was seen with a hole in it from which bloody fæces were exuding, and further escape of its contents prevented, whilst the cleansing away of the pus continued until the lowest collection containing fæces was found in Douglas's pouch. When the disturbed parts had been well cleansed, the hole in the small intestine, through which a pea could have been passed, and which was situated opposite the mesenteric attachment, was closed by a single catgut suture, and two continuous Lembert sutures applied longitudinally made all safe. The lumen was considerably narrowed. The kidney pouches were now wiped out—and the left one needed it. Gauze drains were carried down to both, and another, as well as a rubber tube, was inserted into Douglas's pouch. The damaged coil was placed beneath the wound, which was then closed.

Progress.—For two days the patient's condition was very uncertain. She was very noisy and restless, complained of great pain in the body, and vomited occasionally, but the pulse shewed a tendency to fall. On the twenty-first she was distinctly bet-

ter, and had two spontaneous evacuations. On the twenty-second, the gauze drains were removed, and from this date her progress to convalescence was uninterrupted. She left the hospital well on June 6.

Result.—All trouble, however, was not at end when she ceased to attend hospital. For a long time she had good health, but in January, 1902, nearly two years after the operation, and after a week of abdominal pain, an abscess pointed in the abdominal cicatrix, and burst, and a large quantity of most offensive matter escaped. The opening closed in about three weeks, and there has been no local trouble since. It does not appear that this abscess was associated with a silk suture in the parietes, but it is very possible that the Lembert sutures in the gut had something to do with it. The abdomen now looks quite healthy. There is no protrusion at the cicatrix, and there is no induration or thickening to be felt. Though at present the patient suffers from pain and vomiting after food, suggestive of stomach ulcer, and easily controlled by simple treatment, the only inconvenience which can be definitely attributed to the injury is the pain which follows the taking of aperients. This is no doubt due to the intestinal adhesions resulting from the peritonitis.

CASE 3 was under the care of Mr. Walter Thompson. The record of this case has not yet been published.

Six cases of rupture of the intestine with 4 recoveries are reported by Lund, Nicholls, and Bottomley ("Boston Med. and Surg. Jour.," November 27, 1902, and "Year-Book of Medicine and Surgery," 1904, p. 112). The first 3 cases in the series were operated upon by Lund. In the first case the small intestine was torn from its mesentery for about three inches, and in the centre of the bowel, which was denuded of its peritoneum, there was a large perforation. This patient received his injury from a fall from a bridge. He was operated upon twenty-four hours after the receipt of the injury and soon after his admission to the hospital. The damaged bowel was quickly excised, and an anastomosis was made with a Murphy button. The patient died two and one-half hours after the operation. The second case was one of rupture of the small intestine due to the

kick of a horse. Operation in this case was performed sixteen hours after the accident, and the patient recovered. The rupture in this case was about the size of a lead-pencil, and was partly closed by the pouting of the mucous membrane through it. The third case was also one of rupture of the small intestine due to the kick of a horse. The operation in this case was done nine hours after the injury, and the patient recovered. The fourth case, operated upon by Nicholls, was one of rupture of the ileum due to the kick of a horse. Operation was done three hours after the injury, and the patient recovered. The fifth case, operation by Bottomley, presented all the signs of diffuse general peritonitis, and shewed a perforation in the jejunum opposite the mesenteric attachment. This patient died seventy-two hours after operation. The interesting feature, and the one which makes the case unusual, is that neither from the patient's story nor from that of the witnesses, nor from external sign, could any evidence be obtained of direct contusion of the anterior abdominal wall. The patient was knocked down upon a flat surface by being struck on the back, just below the shoulder-blade, by the shaft of an approaching patrol wagon. The sixth case, also operated upon by Bottomley, and which recovered, was that of a boy eight years of age who was run over by a wagon. The rupture in this case was at about the midpoint of the ileum, one inch from its attachment to the mesentery. The mucous membrane was pouting through the everted edges of the opening and had prevented the escape of much fæcal matter. It is stated that the one thing which means most to both surgeon and patient in these cases is the length of time which is allowed to elapse from the hour of accident to the hour of operation. Beyond the fourth or fifth hour every additional moment of delay adds greatly to the danger of a fatal issue.

Late Results of Incomplete Rupture of the Intestine. — In some instances it would appear that a rupture of the intestine involved the mucous coat only, the peritoneal coat remaining

intact. For several days after the injury there may be melæna, which results from the hæmorrhage from the torn surface. In the healing of the intestinal wound contraction occurs, and a stricture of the intestine thereby results. The following case is recorded by Barker ("Lancet," 1900, vol. i, p. 164):

"A man aged twenty-eight years, a sawyer, was admitted into University College Hospital on February 5, 1900. He had always enjoyed good health until seven years ago, when he was run over by a loaded wagon. The two near wheels, which were broad, passed over the lower part of the thorax, breaking, it is stated, five ribs and splintering another. This was followed by 'pleurisy and inflammation.' He was ill for fourteen weeks, and after this began to have the attacks now complained of. There was no history of syphilis, rheumatic fever, or tumours, but the patient had always suffered from 'heart-burn,' which had been worse since the accident. The patient had always been quite temperate. He had been well fed and had lived among healthy surroundings. His reason for seeking treatment now was extreme weakness and anæmia with periodic attacks of pain and vomiting which set in soon after the accident, seven years ago. These had occurred at intervals of from a week to a month, and lasted from a week to a fortnight. During these attacks pain and swelling began about two inches to the right, and below the umbilicus, and spread from there all over the abdomen. At the same time the patient had vomiting and diarrhœa. The vomit consisted of food and green fluid which tasted bitter and sour.

"Operation was performed on February 22. The abdomen was opened in the midline above the umbilicus. The first thing noticed was a coil of enormously distended and thickened small intestine of white colour, which, for the moment, was taken to be the stomach. It was seen, however, on nearer inspection to lie below the colon, but to overlap it above. The distension terminated to the right of the spine in a sharp kink among many old smooth adhesions, and below this the intestine was normal and empty. On pushing the finger into the distended coil so as to invaginate it a narrow stricture could be felt at the kinked spot. To the left the dilated coil was held down to the spine by adhesions with the first part of the jejunum as it emerged

from under the plica. These adhesions, too, were all smooth and evidently old. I now anastomosed the distended loop with the empty portion below the kink and stricture. This was done by a double row of silk sutures in the usual way. In making the openings in the contiguous loops the contrast between the thick-walled upper portion and the thin-walled normal viscus below was very striking. The abdomen was now closed in with silk sutures. The operation lasted fifty minutes, and towards the end the condition of the patient was not very good. Death took place at 5.15 on the twenty-fourth.

"On opening the distended bowel, at the postmortem, the stricture was found to be due to the contraction of an ulcer produced by the crushing of the mucous membrane where the cartwheel caught it against the spine. It was annular, and the lumen was only about the size of a cedar pencil. Other healed ulcers were seen above it, and some partially healed. The seven feet of bowel between the stricture and the duodenum were enormously dilated and full of pale yellow fluid, like thin custard."

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CHAPTER XXVII.

INTESTINAL OBSTRUCTION.

When called upon to deal with a case of acute intestinal obstruction the surgeon is confronted with one of the gravest and most disastrous emergencies. The patient may be, and often is, a man or woman in the prime of life, in full enjoyment of vigourous health, who, without warning, is suddenly seized with the most intolerable pain in the abdomen, followed by collapse and vomiting, at first slight, but later unremitting. The abdomen distends, intestinal action ceases, and the bowel above the block, loaded with retained and septic contents, becomes a vehicle for the absorption of products whose intensely poisonous action hastens the patient to his end.

It is still, unfortunately, true that in the very great majority of cases the surgeon is called upon to act in too late a stage of the disease. It is not too much to say that in a consecutive series of twenty cases of average intensity, the condition disclosed at the operation will shew that in at least fifteen operation has been too long deferred. To operate early in a case of intestinal obstruction is an experience that few surgeons often enjoy. Allowance must, of course, be made for the early difficulty in diagnosis. There are many cases of acute abdominal pain which a dose of morphine permanently relieves or a brisk aperient drives away. And in its earliest development a case of acute obstruction may differ in no perceptible degree from any of these. The administration of morphine in such a case of acute onset is held to be necessary—to be, indeed, inevitable. But it is not the one dose of morphine which does the harm; it is the needless repetition of the dose. It is not altogether unsafe to say that an acute abdominal pain which a small dose of morphine does not wholly remove is not rarely due to a lesion

within the abdomen that only an operation can relieve. For many of the patients who suffer an acute seizure of abdominal pain a hypodermic injection of morphine is the too-ready refuge of the surgeon. In administering morphine the surgeon is acting with the sanction of the highest authorities, a sanction which, it has seemed to me, has been too readily given. An eminent authority, in a chapter more beautifully written and more pregnant with harm than almost any other chapter in the recent literature of surgery, has said: "Morphine is an absolute necessity in acute intestinal obstruction and should be administered with as little delay as possible," and behind this opinion of one whose word is weighty many of us have been content to shield ourselves. The advice is bad. There is no absolute need to administer morphine—there is no justification for repeating the dose unless means are taken to obtain the opinion of a surgeon, or unless the diagnosis is clear and the practitioner is fully aware of the condition which he is deliberately treating—if, that is to say, morphine is a remedy and not merely a refuge. It is true, as I have said, that many apparently serious cases of acute pain of sudden onset, attended by sickness and perhaps by slight collapse, are relieved of all present troubles by the giving of morphine. But if the condition of the patient is such that a second or larger dose of morphine is speedily called for, the suspicion of the surgeon should be on the alert and the probability (for it is no less) of the condition being one of mechanical block of the intestine or other grave surgical catastrophe should be borne in mind. It is in no small degree the administration of morphine which is responsible for the disastrous results in cases of acute obstruction. The comfort and repose thereby induced mislead the practitioner into the belief that the disease is of trivial import; and yet, during every hour, the pathological conditions within the abdomen are changing for the worse. When the exact state of affairs is revealed on the operation table, it will constantly be found that precious time has passed away, and that the opera-

tion, whether ultimately successful or not, has been performed too late. The surgery of acute obstruction is disheartening work.

The mortality following operations in all cases, early and late, is very large—far larger than it ought to be. Upon this point the evidence of statistics, culled from the literature, is practically worthless. I should be quite prepared to hear that for one success recorded in the current periodicals there are at least five failures. There are few surgeons who, in a series of twenty or more cases, can shew a lower mortality than 50 per cent. Anything over a 10 per cent. mortality (which should be attainable) is the mortality of delay.

An examination into the conditions found at an operation or at an autopsy shews that in all cases two factors are at work in determining the fatal issue. Of these, the first and least important is the mechanical block in the bowel—the actual obstruction. The second, and incomparably the more serious, is the septic absorption from the distended, congested, and perhaps ulcerated bowel above the place of stoppage. It will be clear, therefore, that in operating upon patients so afflicted the relief of the mechanical obstruction is but a part—and that the smaller and less significant part—of what the surgeon must needs do. The overloaded bowel must be emptied of its putrid contents; and no operation should be considered complete until this has been done.

During the operation the surgeon will need all his dexterity, rapidity, and judgment if he is to be successful. In all abdominal operations speed is a desirable thing: here it is an imperative necessity. The surgeon must discover what has to be done, and must do it with all possible despatch.

Two points in the preparation of the patient need to be emphasised. The stomach must be emptied and washed out, and the skin of the abdomen must be carefully cleansed. The stomach is often greatly distended, being filled with a turbid, yellow or brownish-yellow, highly offensive fluid. Some fluid

of this kind has probably been vomited upon many occasions within the few hours preceding operation, but the stomach rapidly fills up again with similar material. If the patient is anæsthetised with the stomach overfull, it not seldom happens that as soon as general relaxation is produced there is a profuse gush of this fluid through the mouth and nostrils of the patient, and if a deep inspiration be taken, the trachea is filled. The patient, indeed, is drowned in his own vomit. The stomach, therefore, must always be emptied. If necessary, the throat may be wiped over with cocaine solution before the tube is passed. After the stomach is emptied it is washed out with two or three pints of hot salt solution until the returning fluid is clear. The anæsthetic is then administered.

Cleansing of the skin of the abdomen must be thoroughly attended to; the application of many linseed poultices, with the imperfect removal of each, may have left a crust of dried linseed over the abdomen; or hot stupes or turpentine may have caused the skin to blister. A general careful cleansing and shaving may be done before the anæsthetic is begun, but a more scrupulous attention may be paid as soon as the patient becomes unconscious.

So far as the anæsthetic is concerned, it must be pointed out that the less there is given, provided insensitiveness is produced, the better. It is too much to ask to have the patient profoundly anæsthetised so that his abdominal muscles may be relaxed or free from the turbulent movements of deep breathing. The previous administration of morphine will have lessened the need for a free administration of either ether or chloroform. If the condition of the patient is bad, the operation may be done under local anæsthesia or under ethyl chloride.

The incision is made in the middle line, unless there are the strongest indications to the contrary. In some few cases, more particularly in those where there is a palpable block in the large bowel, an incision over the exactly determined site may be made. In all other cases a central incision is preferable. In by far the

majority this will render easy access to all the parts that require to be dealt with; in some few, a second incision will have to be made. The first incision, however, will not then have been purposeless, but will have revealed to the surgeon the need for the second, and the position in which it should be made. The central incision, therefore, is generally made between the umbilicus and the pubes. The cut made in the skin is one or two inches longer than that in the peritoneum, in order to allow the edges of the wound to fall away and therefore to avoid impeding the easy movements of the surgeon's fingers, and also to permit, if need be, of a rapid enlarging of the wound.

The incision in the peritoneum should be about three or four inches in length—sufficiently long, that is, to allow the easy introduction of the hand, should this be necessary. Especial care must be taken when the peritoneum is cut, for, owing to the intestinal distension, the bowel-wall may be so closely pressed against the anterior abdominal wall that it may be difficult to avoid wounding it.

When the peritoneum has been opened, the fingers of the surgeon are introduced into the abdominal cavity. As a rule, all the exploration, and all the subsequent manipulations necessary to discover and display the involved gut in the wound for appropriate treatment, can be effected by the three fingers passed through the incision. But occasionally it is necessary to pass the whole hand up to the wrist within the abdomen so as to explore, with precision, some otherwise inaccessible corner of the abdomen. When the surgeon wears gloves, there is very little likelihood of his wounding the gut or of doing any damage whatever by gentle manipulation. The introduction of the whole hand has been described as a brutal and a clumsy procedure, certain to damage the gut and to split its peritoneal surface. With reasonable care, however, no damage need be done. When the fingers or hand are within the abdomen, the cæcum is first sought. If it is distended, the block must be in the large bowel. If it is collapsed and empty, the block will be in the small in-

testine. I have found that it is then the safest course to explore the pelvis, for it is remarkable with what persistence the involved loop finds its way into this region. The counsel is generally given that, after the cæcum has been explored, the hernial rings and the umbilicus should be examined, for in these places the strangulation is not rarely discovered. But in my own experience a search in the pelvis has been more quickly rewarded.

It is probable that there are few occasions in surgical practice which are so much simplified by previous experience as the search for the cause, within the abdomen, in a case of acute obstruction. In one's early cases the fingers within the abdomen seem to meet with no part that is capable of being recognised; there is no landmark, and the fingers are apt to wander aimlessly. But by degrees experience comes, and after a few cases have been explored it is easy to feel at home in the abdomen and to recognise any obstruction without serious difficulty. If after three or four minutes the surgeon is unable to define the obstruction, it is better to follow the plan of Kümmell and to allow much of the intestine to escape from the abdomen. Before this is done a towel wrung out of hot sterile salt solution is placed on each side of the wound, and as the bowels escape, the towels are folded around them to keep them warm and protect them. The towels are changed when cooled, but, as a rule, with a deft and speedy operator, the intestines are out of the abdomen only a very short time and a change of towels is not necessary. As soon as the point of obstruction is located the constriction is relieved, in a manner to be specially considered. When this has been done, the distended coils are relieved of their contents by an incision. This is performed in a manner which has already been described. The bowel into which the opening is to be made is lightly clamped by an assistant's fingers, and a longitudinal incision, about 1 inch in length, is made in the line opposite the mesenteric attachment. The edges of the wound so made are lightly seized with small vulsellum forceps,

and are held apart, while a glass tube, about 8 inches in length, is introduced and passed upwards in the lumen of the gut. I have a tube of special design for this purpose. This tube has an oblique opening at one end, and a double-ringed flange at the other. The smaller flange holds tight a rubber tube which is threaded over

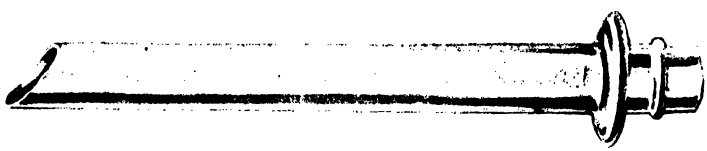


Fig. 183.—The author's tube for use in intestinal obstruction.

it. The larger marks the limit to which the bowel is ondrawn. To the outer end of this tube a long, thick rubber tube is attached, and this leads into a receptacle beneath the table. The tube is pushed gently upwards in the distended gut until its outer end reaches the margins of the wound in the bowel. The tube and gut are then seized in a wrap of sterile gauze and held



Fig. 184.—The bowel being pushed gently along the tube.

firmly by an assistant so that no leakage occurs by the side of the tube. The surgeon then, with the greatest gentleness, pulls the intestine on to the tube and thereby empties the bowel a little higher up. Gradually more and more of the bowel is pulled onwards until as much of it as the tube will take has been emp-

tied. It will be found that upon a tube six inches in length a portion of the bowel six feet in length can easily be held. In pulling the gut gently on to the tube it will be found to make matters easier if a piece of gauze be used to hold it. If the whole of the distended gut cannot be pulled upon the tube, a piece of the bowel at the highest point which can be reached is seized, secured by an assistant, and "milked" steadily downwards by the surgeon. All this can be, and must be, done very

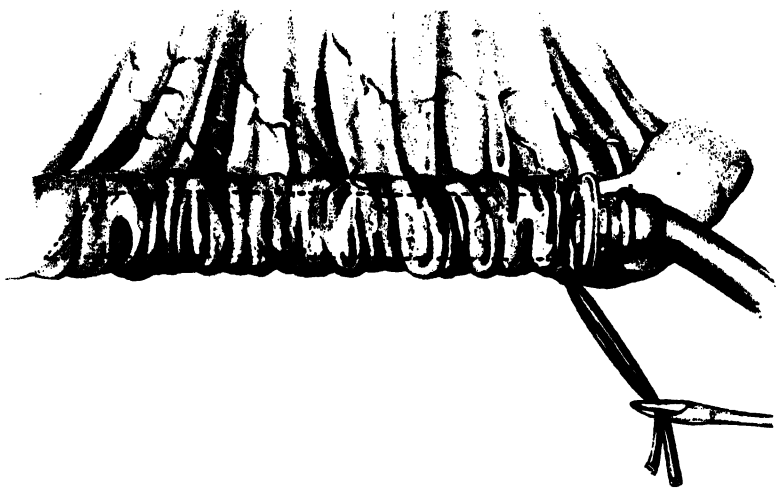


Fig. 185.—To shew the position of the tube when as much of the gut as possible has been drained by it.

rapidly. The tube is then gradually withdrawn, and the opening in the bowel covered over by a gauze swab until all the rest of the intestine has been returned within the abdomen, where it is covered with a hot gauze swab. The bowel opening is now closed by a double layer of stitches (the wound being stitched transversely), the whole loop carefully washed and cleansed, and returned gently within the abdomen.

Such is the procedure in the simplest of all cases. There is no need for such an operation to last for more than twenty minutes. The only time-expending part of the operation is

the search for the obstruction—it is better not to delay in the search, but if there is doubt or difficulty, to allow the intestines at once to escape. The fixity of a loop, the appearance, side by side, of a distended and of a collapsed coil, will often give the clue to the affected part.

During the manipulations necessary for the freeing of the involved loop and for the emptying of the bowel the closest possible protection of the remainder of the abdominal contents must be ensured. Hot gauze swabs in two layers are packed around, and, if soiled, are changed as speedily as possible. The utmost daintiness must be observed throughout. If the glove of the surgeon or of his assistant is soiled, it should be changed at once. In the majority of the cases of intestinal obstruction upon which I operate I find it necessary to change my gloves at least once during the operation.

THE OPERATION IN SERIOUS CASES.

In the operation above described, though speed is important, yet the search for the cause of the obstruction and its removal can be carried out deliberately. In some cases, however, unhappily too frequent, the patient is so prostrate and is suffering so profoundly from toxæmia that any investigation within the abdomen, or any, even the slightest, exposure of viscera, cannot be borne. In such circumstances relief must be afforded to the patient by the simplest and speediest procedure. No enquiry can with prudence be made into the cause or conditions of obstruction; treatment begins, and for the time being ends, with the emptying and draining of the acutely distended bowel.

The patient will probably not be in a condition to bear a general anæsthetic, and cocaine or ethyl chloride will then be used locally. The stomach should always be washed out if it is at all possible for the patient to bear the ordeal.

The abdomen is opened through a very small incision, the peritoneum being incised with care. At once a distended and

deeply congested coil will present itself in the wound. This, by a curious and most fortunate chance, will prove to be in almost every instance that portion of the gut which subsequent events will shew to be best adapted for the purpose of forming an artificial anus. As the intestine gradually distends above the point of obstruction, it is found that the coils which are first most widely distended—those, of course, immediately above the stenosis—seem always to force their way to the front of the abdomen and to press against the anterior abdominal wall. The first coil, therefore, selected at random, as it lies beneath the median incision, seems, with few exceptions, to be that which a prolonged and arduous search would justify as the one to be selected for opening and draining.

In cases of acute obstruction in the small intestine supervening upon chronic obstruction, as in growth or tuberculous disease, it will always be found that the mesentery of the distended coils above the stenosis is decidedly longer than that below. In extreme cases the mesentery may be doubled in length.

The small opening in the abdominal wall being made, a prominent and distended coil is selected and stitched all round to the parietal peritoneum. The stitch should be continuous, and should be passed with scrupulous care, so that any wounding of the mucosa or a deep puncture of the gut with leakage may be avoided. The stitches are close together and secure a mechanical partition between the bowel in the wound and the general peritoneal cavity. The suture being completed, a small incision is made in the bowel in the centre of an oval area marked off by a purse-string stitch. As soon as the bowel is opened, a glass or thick rubber tube is passed into the gut and the purse-string suture is tied snugly around it. This secures, for a few hours at least, the passage of all the intestinal discharges and prevents the soiling of the abdominal wound. The stitch gradually loosens, and the tube may then fall out, but by this time the line of suture of the bowel to the parietal perito-

neum is effectively sealed off, and no peritoneal contamination is possible.

The tube will probably drain away a very large quantity of flatus and thin, fæculent fluid for many hours, with the result that the patient's condition may slowly improve, the symptoms of intense toxæmia disappear, and some measure of health and vitality be restored.

When the experience of the profession prior to the last fifteen years was collated, it was found that the operation here described the simple formation of a fæcal fistula, without the investigation of the obstructing cause was attended by the best ultimate results. A larger number of recoveries followed upon this than upon any other method of treatment. Recent advances, both in the understanding of the pathology of obstruction and in the means of dealing with all abdominal diseases, have relegated this measure to its proper place—that of a procedure to be practised only in desperate straits.

It cannot be said that the method is one to be generally commended. That lives are saved by this means is undoubted, but it is not improbable that many of the cases formerly believed to have been rescued from impending death were not cases of mechanical obstruction at all, but were cases of acute appendicitis with spreading peritonitis, that, by the practice of to-day, would be treated differently and with greater success by an operation directed to the removal of the cause.

The formation of a fæcal fistula in the small intestine, though, as has been said, it may rescue the patient from a seemingly inevitable death, leaves him with perils of considerable magnitude to face. The death-rate among successful cases of enterostomy when submitted to subsequent operations is large. There are cases in which no further operation is necessary. The fæcal fistula which has been formed gives vent to an abundance of fluid and flatus, and gradually closes spontaneously. Such cases were more common ten or twenty years ago than they are to-day. This is almost certainly owing to the fact,

previously mentioned, that the cases were not veritable examples of mechanical obstruction. In the great majority of the patients a second operation is needed.

In cases of mechanical obstruction of whatever variety the performance of enterostomy may leave behind a condition of things from which recovery is not possible. Though the patient rallies from his prostrate or even moribund condition, an ensnared loop of gut—a volvulus—or an intussusception may be progressing steadily towards gangrene. The patient, though relieved from one of the two factors which make for death, is left to die, without chance of escape from the other. A successful enterostomy, therefore, may still be unable to avert death, which may come from a condition unrelieved by the operation or from the necessary surgical measures which must be adopted for the closure of the drainage opening.

The operation of enterostomy, therefore, though undoubtedly a life-saving measure, to be remembered, and to be employed when circumstances dictate, is, nevertheless, one to be used with reluctance, to be considered only in the last extremity of the patient's distress.

The opening into the bowel should not be allowed to discharge any longer than is necessary. As soon as the patient has rallied, measures should be adopted to close the fistula.

Before the secondary operation is undertaken the surgeon will endeavour to satisfy himself of the permeability of the bowel below the fistula. The administration, by the opening, of food or of aperients will shew whether the passage through the bowel, temporarily interrupted, has been restored. If, happily, this is the case, the secondary operation will be simple and will be concerned only with the closure of the unnatural opening by methods already described. If, however, the bowel remains impermeable,—if, that is to say, the mechanical impediment still persists,—the secondary operation will include a necessary investigation of all the bowel below the obstruction and the relief of any gross lesion which may therein be discovered. At-

tention has already been called to the fact that after the establishment of a fæcal fistula the bowel distal to the new opening undergoes a remarkable change. The coils of which it is composed become thin, flaccid, empty, and contract adhesions with each other and with any structures in contact with which they lie. The disentangling and unravelling of these may be a difficult, even an impossible, matter, so that a restitution to activity of the bowel has to be abandoned and a short-circuiting operation is performed.

SPECIAL CIRCUMSTANCES IN OPERATIONS FOR INTESTINAL OBSTRUCTION.

The special circumstances concern themselves with the removal of the cause of the obstruction. Each case must be treated as necessity demands.

Strangulation by Bands.—Bands are almost invariably attached by one end to the mesentery, and are generally solitary. They may be short or long; as a rule, the shorter they are the more intense is the strangulation produced by them. They are generally vascular, and if divided, may bleed from both cut ends. As a rule, bands develop in connexion with enlarged glands in the mesentery or from adhesion of the omentum to some acutely inflamed organ, such as the appendix, the ovary, or the Fallopian tube. It will often be found that the manipulations necessary to the proper disclosure of the part of the gut strangled by the band suffice to tear the band, and so to set free the entangled coil. If possible, however, the band should not only be broken through, but entirely removed. Two clips are placed on the band, one at each end, and the band is divided between them. A ligature is then applied on each clip, and the loose portion of the band at each end is snipped away with the scissors. Unless a band be removed in this fashion it is not improbable that it may reform or the tags be the means of leading to the deposit of new bands of lymph, which eventually become organised.

Although a band is usually solitary, the possibility of there being two bands must always be remembered. Gibson found that in 17.5 per cent. of cases ($\frac{35}{186}$) there were more bands than one. When a band very tightly constricts the bowel, and especially if operation has been unduly delayed, all the coats of the bowel except the serosa may have given way, and the serosa itself, if not actually perforated, may be so flimsy and friable that the slightest manipulation will tear it. Leakage from the intestine will then occur, and unless the surgeon be on his guard, the wound may be flooded with the septic intestinal contents. It should be the surgeon's aim, therefore, so to surround the band and the intestine it compresses with a double layer of protective swabs, that any escape of contents may not soil the surrounding viscera. Especial care should also be taken to see that an assistant's fingers are closely compressing and clamping the gut before the ensnared loop is free.

In tuberculous disease of the peritoneum involving the glands in the mesentery a long loop of intestine may be compressed by bands at several points. There may be an intricate mesh of adhesions, difficult or impossible to disentangle. After the division of two or three strands a further pursuit of them will be found inadvisable, and a short-circuiting operation will then probably be considered necessary.

Meckel's diverticulum may cause obstruction in several ways. That with which we are now concerned is the form in which the pouch acts as a band, its extremity, normally free, being attached at the umbilicus, to the mesentery, or, indeed, to any point within the abdominal cavity. It may be difficult to recognise the diverticulum, owing to its resemblance, sometimes very close, to a piece of normal intestine.

After the diverticulum has been freed at its extremity it should be removed a short distance away from the intestine. A clamp is applied and compresses the diverticulum as tightly as possible, until, at the line clamped, only the serous coat remains. A single catgut ligature is then applied in the groove

left after removal of the clamp, tied tight, and the diverticulum beyond it cut away. A continuous seromuscular stitch is then passed, so as to bury and infold the catgut ligature and the portion of gut which it controls.

Internal Hernia.—The whole subject of internal hernia is dealt with fully in the author's work, "Retroperitoneal Hernia," to which the reader is referred.

In instances of either right or left duodenal hernia the orifice of the hernial sac is bounded in front by vessels—the superior mesenteric artery in *right*, the inferior mesenteric vein and the left colic artery in *left*, *duodenal hernia*. In the examination of the neck of the sac great care must, therefore, be taken to avoid wounding of these vessels. It will perhaps be found that the acute intestinal obstruction is due not so much to an actual compression at the neck of the sac as to a volvulus of the bowel; all the gut within the hernial sac is twisted round the entering and returning loops. A gradual disentanglement of the intestine at the neck of the sac will then permit the withdrawal, little by little, of the imprisoned coil. The neck of the sac may sometimes be enlarged by gradual traction of the finger or by a nick made in the neck at a point where no vessels are. When the gut has been withdrawn from the hernial sac a few stitches must be passed at the neck so as to close, as nearly as possible, the entrance to the cavity.

Cases of retrocolic hernia and of intersigmoid hernia are dealt with in a similar manner.

Hernia into the foramen of Winslow has been recognised in eight cases. The difficulty of even a partial reduction of the hernia and the impossibility of reducing the whole of it are well shewn by Treves's case.

Hernia through abnormal openings in the mesentery or in the broad ligament have occasionally been observed. As a rule, the reduction of the bowel offers no difficulty, for the margins of the opening are readily enlarged by stretching with the fingers or by cutting at a point free from vessels. The com-

monest point of the mesentery to shew an opening is that which runs to the lower ileum, and it is this portion of the bowel which most often passes through the opening.

Intussusception.—The relative frequency of the various forms of intussusception has been investigated by Sargent. In 109 consecutive cases occurring at St. Thomas's Hospital there were—

Of the ileocæcal variety	75
" enteric "	12
" ileocolic "	5
" colic "	5
Double or unusual forms	12

Leichtenstern, dealing with a total of 593 recorded cases, found the following proportions:

Ileocæcal	44 per cent.
Enteric	30 "
Colic	18 "
Ileocolic	8 "

Of the 593 patients, 134 were under twelve months, and of these, 80 were between the fourth and sixth months.

Males are more frequently affected than females. It is still a common practice to attempt the reduction of an intussusception by inflation. The method is uncertain—deceptive, in that reduction may be apparently complete and in reality be only partial—and by no means devoid of risk. The tendency of surgeons is very properly to abandon it, or to use it only in conjunction with an abdominal operation. If the abdomen be opened and inflation employed, the surgeon may watch the gradual reduction of the invagination until only the first portion of it remains. The reduction of this, as can be seen, is a matter of great difficulty and is frequently never achieved. It is then supposed that the intussusception "recurs" after reduction, the truth being that the intussusception has never been reduced. Inflation may, if it is thought desirable, be used to reduce the greater part of the reduction, the undoing of the last

portion being effected through an abdominal incision. Otherwise the method of inflation is one to be abandoned. It is the relic of an age of ruder surgery.

Mr. Eve ("Brit. Med. Jour.," September, 1901, p. 582), in reviewing his record of cases at the London and Evelina Hospitals, sums up the arguments against inflation and injection in this way: (1) They are very rarely efficacious. Of 24 cases so treated, not one was cured by these methods alone. Eighteen cases were subsequently operated upon, and 6 died without operation. Of the 18 cases subjected to operation, in 14 reduction was effected, although inflation or injection had failed in procuring it. (2) Injection or inflation was not infrequently followed by an illusory or partial reduction. So-called recurrence of the displacement was inevitable, and the consequent delay in performing the operation usually led to a fatal result. (3) Injection or inflation was haphazard, and, therefore, unscientific.

In all cases of intussusception the child must be safeguarded from the effects of shock by special care in the preparation and conduct of the operation. The limbs must be swathed in wool and bandaged with a flannel bandage, the room must be warm, and the operator must be speedy in all his movements. As little anæsthetic (chloroform) as possible should be given.

When the abdomen is opened, the intussusception is, if possible, reduced. In the early stages reduction will offer no difficulties; after three days or longer it may be impossible.

Reducible Intussusception.—The abdomen is opened through an incision about 1½ to 2 inches in length, between the umbilicus and the pubes. Sufficient room must be given at once for the introduction and free movement of the fingers. When the lower limit of the intussusception has been defined, the bowel immediately below is gently grasped with the fingers and thumb of the right hand and upward pressure is exerted. With very gentle squeezing of the apex of the intussusception it will be

pushed a little upwards, and the invagination, therefore, will be a little reduced. As this happens the fingers are made to travel slowly upwards again, compressing the tip of the intussusception and again effecting a slight reduction. Little by little the ensheathing layer is unrolled and the invagination travels backwards, in the ileocæcal variety, from the descending colon along the transverse colon and ascending colon until the cæcum is reached. The same gentle squeezing movement is continued all the time, the hand being slowly moved along the

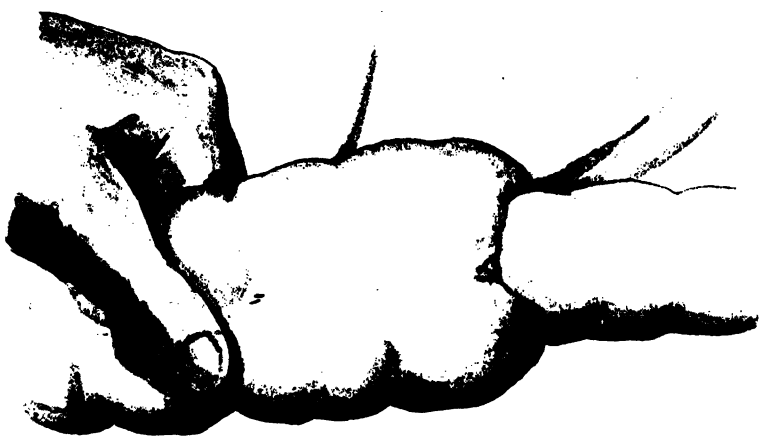


Fig. 186.—Reduction of an intussusception by pressure from below.

bowel. When the cæcum is reached the main difficulty will be encountered. This is in the reduction of the apex of the intussusception, which is often swollen, sodden, and œdematous. To effect the setting free of this last portion the cæcum should be brought up to the wound so that the manipulations may all be carried out under the eye of the surgeon. The same gentle pressure upon the colon and very slight traction upon the ileum are together exercised until all the invagination is undone. The successful completion of the manœuvre is often

demonstrated by the appearance of the vermiform appendix. The gentlest possible manipulation is necessary throughout, in order to avoid a rent in the peritoneum. Should this occur, an avenue will be opened for the escape of organisms from the bowel and a septic peritonitis may result. If any rent be made, it must be closed by a very fine continuous suture of thread.

Instead of using the finger and thumb the two index-fingers may be used for pushing upwards the invagination. A sort of stroking movement, one finger being moved after the other, is used.

After the completion of the reduction it is desirable, if time and circumstances permit, to pass a few sutures uniting the cæcum to the peritoneum of the right iliac fossa. In the very great majority of cases of ileocæcal intussusception there has been an absence of that "secondary fusion" which fixes the ascending colon to the posterior abdominal wall. It is the undue mobility of cæcum and ascending colon which permits the occurrence of the invagination. If the colon and cæcum are fixed by a few points of suture, recurrence of the intussusception is rendered improbable. This operation may be called "typhlopexy."

If the intussusception has been an enteric one, the mesentery may be folded upon itself by suture, with the object of eliminating that undue length of the mesentery which is a recognised predisposing cause of intussusception. Dr. A. N. McGregor, of Glasgow, who first suggested this point, writes ("Glasgow Medical Journal," October, 1903):

"After reduction, a long catgut thread was fixed at a point in the mesentery of the ileum, proximal to the intussuscepted portion, about half-way between the bowel and the root of the mesentery. Thence a continuous Lembert suture was applied so as to tack together a fold produced by approximating the distal and proximal edges of the mesentery. The fold was gradually increased from the commencement of the suture to a point opposite

the apex of the intussusception, and then gradually diminished to a point distal to the lower end of the lesion. By this method the blood-vessels of the mesentery are not interfered with, the stitches only involving peritoneum. No loophole is left for an internal hernia. It has the advantage of requiring no new apparatus, and need not increase the time of operation by more than five minutes.

"The effect of this procedure seems to be twofold. In the first place, the shortening of the mesentery removes one of the admittedly common predisposing causes; and, secondly, the three-ply of mesentery—and œdematous mesentery, too - may act as a splint, and so prevent the doubling in of the bowel at the seat of the old lesion."

Irreducible Intussusception. In some cases, despite the earnest effort of the surgeon, the invagination may prove to be irreducible. The following courses are then open:

If *irreducible, but not gangrenous*, the intussusception may be ignored, a short-circuiting operation being performed, the bowel above the mass being anastomosed with that below. This, as a rule, is permissible only in cases of chronic intussusception, where gangrene is not only not present, but is not to be feared. If *irreducible and gangrenous*, one of three operations may be done: (*a*) The whole mass may be excised, and an end-to-end or side-to-side anastomosis performed; (*b*) or Jessett's operation, removal of the invagination alone, through an incision in the sheath, may be practised; (*c*) or resection and the formation of an artificial anus may be performed.

(*a*) *Resection with end-to-end union of the bowel* does not differ from the same operation when practised for growth or stricture or tuberculous ulcer of the intestine. Where the disparity in size between the cut ends of the bowel is very marked, it is better to close both ends and perform a lateral anastomosis.

(*b*) Jessett's operation is thus described by its originator:

"In three experiments on dogs I made an artificial intussusception by invaginating a considerable length of small intestine

into another portion of intestine lower down. I then fixed this in position by means of a few Lembert sutures. At the end of

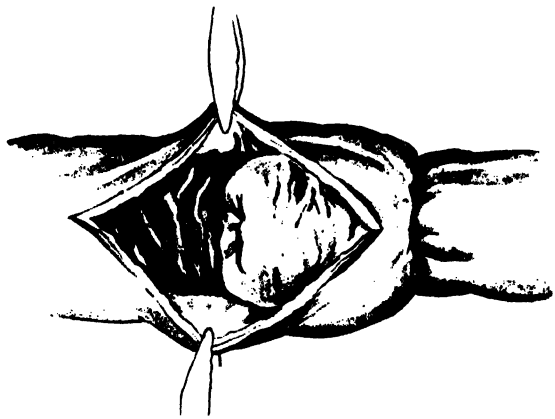


Fig. 187.—Jessett's operation for intussusception. The sheath opened to expose the intussusceptum, which is dragged downward as far as possible before removal.

a week I opened the abdomen of the dog again (under an anæsthetic) and found the invagination firmly adherent in two cases.

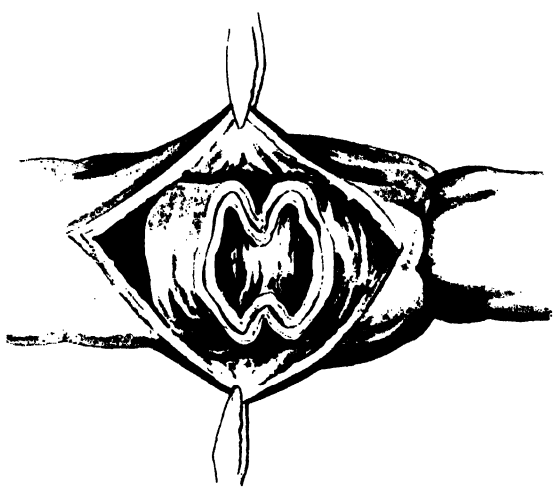


Fig. 188.—Jessett's operation. Removal of the intussusceptum. The division is made a little closer to the neck than in the diagram.

I then made a longitudinal opening into the intestine, on the side furthest from the mesentery, directly over the intussuscep-

tum, about 1½ inches long, or of sufficient length to allow of my being able to have a good view of, and room to cut across, the root of the invaginated portion through the opening. I next, with a pair of scissors, cut this through close to its fornix, and,

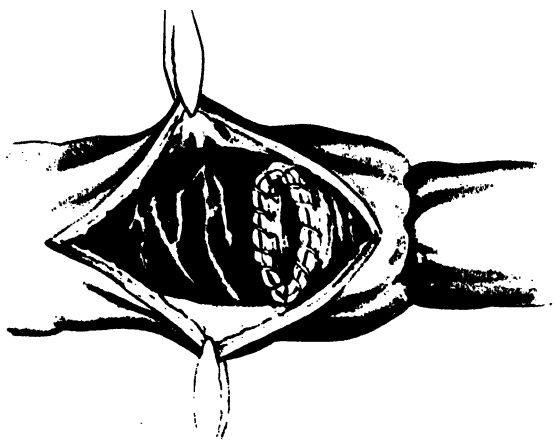


Fig. 189.—Jessett's operation. Suture completed. The stump of the intus susceptum is now withdrawn and the incision in the sheath closed.

drawing it out of the intussuscipiens, ligating any vessel that required tying; then, with a few sutures, I stitched the cut ends together. The stump was then returned into the intestine, and the opening through which it had been drawn out was closed by



Fig. 190.—Jessett's operation completed. A few interrupted sutures are placed at the neck, and the longitudinal incision is closed by continuous sutures.

a double row of quilt sutures, and the part dropped back into the abdomen. In one case I sutured the intestine together at the junction of the intussusception part with the lower portion of the bowel, but this is not, I think, at all necessary. These

experiments were successful, and there were no bad symptoms afterwards."

The operation was first practised by Mr. Arthur Barker, who independently devised an almost exactly similar procedure. The following is his description:

"At the point at which the intussuscipiens receives the intussusceptum, the two portions of the bowel are at once united by a continuous circular suture of fine silk, taking up the serous and muscular coats of each, and carried on to the mesentery. A longitudinal incision is then made for about two inches through all the coat of the intussuscipiens on its free margin. This gives access to the sausage-like intussusceptum within. The latter is then drawn out through this incision, and is cut across close to its upper end, or, if too long to be first drawn out, it may be cut across *in situ*. A few stout silk sutures are, however, passed through all the walls of the stump as the mass is gradually cut off, and are tied tightly so as to keep the serous surfaces in contact and control all bleeding from the vessels entering it at its mesenteric attachment. The stump is now cleansed, dried, and dusted with iodoform, and is allowed to drop back through the incision into the lumen of the intussuscipiens. Then the longitudinal incision in the latter is closed by a continuous suture from end to end. Toilet of the surrounding parts and closure of the abdominal wound complete the operation, which in my first case only lasted half an hour, and in my second, a little longer. In a future case I shall look forward to finishing the whole operation in a much shorter time and with much less manipulation. Now, in this operation the resulting junction of the bowel is just what we aim at in the far more elaborate procedure of direct resection of the bowel. But we have the great advantage, besides the saving of time, of not interfering with possible adhesions at the point of strangulation or with the mesentery. Moreover, the vessels of the latter are probably blocked by the strangulation at a point above that at which they are cut, and, if they are not so, they are closed by the same sutures which bring together the divided edges of the stump."

(*c*) *Resection with the formation of an artificial anus* is unsuited to the conditions of childhood, and should, therefore, be

practised only when other measures are, for some reason, utterly impossible. A later closure of the anus will, of course, be necessary. A successful case of this kind has been recorded, but the method is not one to be commended.

After the reduction of the invagination has been accomplished an examination of the bowel should be made in order to determine whether any polypus, projecting into the lumen of the bowel, is the cause, or whether a Meckel's diverticulum, inverted, has formed the starting-point. If a growth be found, the intestine must be opened and the polypus removed, or, as in a case recorded by Mr. Rutherford Morison, the whole of the portion of the bowel bearing the polypus may be excised.

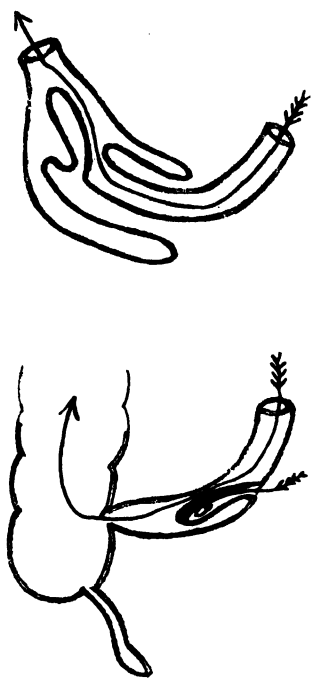
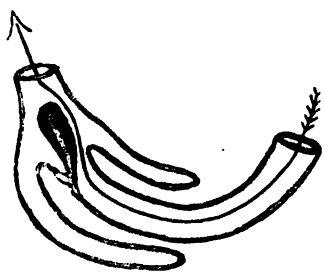


Fig. 191.—Intussusception due to an inverted Meckel's diverticulum (Rutherford Morison).

Mr. Rutherford Morison records a case of intussusception occurring in a boy aged five, due to a Meckel's diverticulum ("Lancet," June 14, 1902, p. 1689):

"A tumour was felt in the left loin, and over it an incision was made and the invagination, which was six inches in length, was withdrawn from the abdomen. The mass was wrapped in a large warm flat sponge and steadily and firmly squeezed until its size was evidently lessened. The bowel was then steadily reduced by gentle traction from above and pressure from below. On its reduction a firm tumour of about the size and shape of the little finger could be felt through the intestinal walls in the lumen of the bowel fixed to the wall opposite to its mesenteric attachment. At the site of attachment a definite dimple was observed, and this suggested that the tumour was an inverted

Meckel's diverticulum which had formed the apex of the intussusception. A longitudinal incision one inch long was made in the intestine, and the diverticulum, for this it turned out to be, was excised. The intestinal opening was closed transversely by a continuous catgut suture through all the coats, and outside of this was inserted a row of Lembert's interrupted sutures of catgut. The specimen shewed an intestinal diverticulum turned completely inside out, measuring one and a half inches in length, becoming wider from base to apex and ending in a somewhat bulbous extremity. There were patches of gangrene in its wall affecting chiefly its mucous membrane. The patient recovered."



A second case of intussusception due to a polypus is also related:

"The patient was a man aged sixty-two. On opening the abdomen a large, rounded, firm swelling was found in the ascending colon—evidently an intussusception. It extended from the right iliac fossa to the middle of the transverse colon. By expression and traction the intussuscepted gut was readily reduced, except the last two or three inches. This was towards the end of the ileum, and contained a firm, rounded tumour which was at this time suggested to be a carcinoma invading the ileocæcal valve. The portion of intestine including it, along with the thickened mesentery and some enlarged glands, was excised. The mesentery and intestine involved in the intussusception were so thickened and altered by old adhesions that until the excised portion and cut ends were carefully examined it

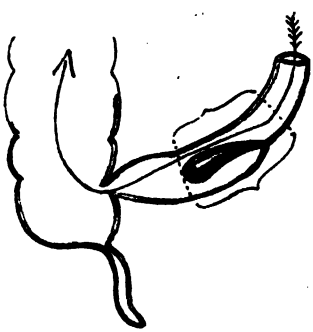


Fig. 192.—Intussusception due to a polypus of the intestine (Rutherford Morison).

was not recognised that the portion removed concerned the ileum only and that the distal incision left two inches of ileum attached to the cæcum. The divided intestine was thickened and friable and was too rigid to allow of a lateral anastomosis. An end-to-end union was effected by a continuous suture of catgut through all the coats, and outside of this an interrupted layer of catgut sutures. The loose omentum was drawn down and wrapped around the anastomosis. The opening in the abdominal wall was entirely closed by four tiers of interrupted catgut sutures. The portion of gut resected measured three and a half inches in length and had a diameter of one and three-quarter inches. The intestinal wall was very thick. The mass in its interior was found to be a rounded polypus of the size of a large walnut, which sprang from the antimesenteric border. On the outside of the intestine, opposite the attachment of the growth, there was a distinct pucker on the peritoneal surface, but it led into no channel, as in the previous case. A microscopical report by Dr. R. A. Bolam states that 'the tumour consists of young connective tissue with numerous vessels. In parts, the appearances suggest myxomatous change, but this may be accounted for by the œdema. The surface of it is covered by normal mucous membrane.' The patient recovered."

The following table, shewing the results of operations at different times from the onset of symptoms, is given by Sargent:

Day.	Number of Operations.	Percentage of Reducible Tumours.	Resections, etc.	Mortality.
First,	35	94 per cent.	2 resections.	37 per cent.
Second,	36	83 " "	3 resections. 3 artificial anus.	39 " "
Third,	33	61 " "	9 resections. 4 artificial anus.	61 " "
Fourth,	15	40 " "	9 resections.	67 " "

The fifth and sixth days shewed respectively a mortality of 73 per cent. and 75 per cent.

Clubbe ("Brit. Med. Jour.," April, 1901, p. 689) records 45 cases of intussusception upon which he had operated during seven years. Of these, 24 recovered and 21 died. In the successful cases the time which elapsed from the onset of symptoms

until the operation averaged twenty-four hours, whereas in the fatal cases the average time was fifty-six hours.

The experience of all operators coincides with this, and the imperative necessity of early diagnosis and early operations is universally admitted.

At the Clinical Society of London a discussion was held on December 9, 1904, on the treatment of intussusception. The following report is quoted from the "Lancet," December 17, 1904, p. 1719:

"Mr. Cuthbert S. Wallace read a paper on the 'Treatment of Intussusception in Children,' based on a series of cases of intussusception in children treated at St. Thomas's Hospital and the East London Hospital for Children between the years 1898 and 1904. There were 20 cases in all, the ages varying between three months and thirty-three months. There were 12 males and 8 females. Of the 20 cases, 19 involved both the small and large guts; the remaining case was one of the colic variety. Eleven were single tumours and 9 were double. Mr. Wallace believed that double tumours were more common than was generally supposed, and he referred to the difficulty of nomenclature that was encountered if a complete classification was attempted. The diagnosis was clinched by the finding of a tumour, and if there was any doubt of the presence of a tumour, an anæsthetic should be given and the matter settled at once. The treatment was primary cœliotomy, the most convenient incision being through the right rectus beside the umbilicus. Mr. Wallace did not lay any great stress on the reduction of the tumour within the abdomen, but thought that time was the most important element in the treatment. The after-history of the cases seemed to shew that, as far as the ultimate result was concerned, the method of suture of the abdominal wall was immaterial. The method favoured was by deep sutures through the whole thickness and buried sutures through the sheath of the rectus. By this method the danger of the incision coming open from failure of union was reduced as far as possible. Of the 20 cases, 4 died, giving a case-mortality of 20 per cent. If the 2 cases of resection were excluded, the case-mortality fell to 11.11 per cent. Mr. Wallace finally referred to the great fall

in the case-mortality that had taken place of late years. Statistics drawn from the records of St. Thomas's Hospital shewed that there was a marked increase in the number of cases of intussusception admitted to hospital.

"Mr. C. H. Fagge read a paper on the 'Treatment of Intussusception in Children by Laparotomy,' founded on the results of 18 laparotomies, of which 17 were primary and 1 was undertaken after two attempts at reduction by inflation had failed. In 16 a tumour was discovered either per abdomen or per rectum. He drew attention to the variable position occupied by the tumour, and insisted on the importance of routine rectal and bimanual examination, if necessary under an anæsthetic, as aids in coming to a prompt diagnosis. The time which elapsed before operation in his cases varied from five hours to three weeks; and though there was no direct relation between this and ease of reducibility, he pointed out that no case in which the duration was less than forty-eight hours had been irreducible. Eleven were single and 7 double intussusceptions, of which at least 10 were ileocæcal and 3 colic-ileocæcal. He did not regard a minute division of intussusceptions into many varieties as of much clinical value. Probably 8 of his cases would not have been, owing to their origin above the ileocæcal valve, in any way affected by inflation or irrigation. Reduction was by laparotomy, carried out with all possible speed through an incision, usually in the right semilunar line, and this was aided, if necessary, by an assistant's finger in the rectum, which reduced the intussusception well into the descending colon. Five cases were irreducible and all of these were fatal; in one an artificial anus was formed, and in all the others resection was performed and the ends of the bowel were united—in one, by Maunsell's method and in the other three by simple end-to-end anastomosis with two rows of sutures, the inner passing through all the coats and the outer through the muscular and peritoneal coats. In another fatal case in which the invagination was reducible no surgeon had been called in for twenty-four hours, and though reduction was easy, the patient, a boy nine years old, died on the fourth day. Of the 18 cases, 7 died, giving a mortality of 39 per cent.; of the reducible cases (13 in all), 2 died, a mortality of 15.4 per cent.; in the 14 cases under one year the mortality was 21.4 per cent., or, excluding the 2 which

were irreducible, there was only one death, giving a mortality of 8.3 per cent. In all the fatal cases a considerable time had elapsed between the occurrence of the intussusception and the operation. A table of the cases was submitted.

"Mr. A. E. J. Barker remarked on the large number of double intussusceptions recorded in the papers. He had never seen a case of this nature, although he had operated on between twenty-five and thirty cases. He agreed with Mr. Fagge that escape of the bowel from the abdomen at the time of operation was a most undesirable complication. He differed from both Mr. Wallace and Mr. Fagge as to the length of incision necessary, and it was rarely advisable, he thought, to make one over two inches long. He attributed the cases just described of bursting open of the wound to this factor, as he had never seen such an occurrence in his cases. In this connexion he believed it was important to conduct the first dressing under opium and chloroform. Some cases incurred toxæmia after the operation; it was probably explained by intestinal sepsis in and around the injury. He had several times noted a rise of temperature on the following day to 105° F., and even 107°, there being no diarrhœa, distension, or other symptom. He had never seen recovery after resection in gangrenous cases, and never expected to see it. The only hope lay in early operation."

Clubbe ("British Med. Journal," vol. i, 1905, p. 1327) reports 100 consecutive cases of intussusception in children. He writes:

"I find that up to November, 1904, I had performed 100 laparotomies for intussusception in children, with 63 recoveries and 37 deaths.

"The first 50 cases occurred from August, 1893, to April, 1901 (a period of 7 years and 8 months); of these 25 lived and 25 died. The second 50 cases occurred from April, 1901, to November, 1904 (3 years and 6 months); of these 38 lived and 12 died. The great difference in the mortality in the second 50 cases is probably due to the fact that the children were sent into the hospital earlier.

	Cases that Lived.	Cases that Died.
Average time from onset of symptoms to operation, first 50.....	28 hours	68 hours.

Average time from onset of symptoms to operation, second 50	23 hours.	48 hours.

"The varieties were as follows:

	Cases.	Cured.	Died.
Ileocæcal	64	43	21
Ileocolic	12	7	5
Double	20	11	9
Colic	3	2	1
Enteric	1	–	1
	100	63	37

"In my cases the relative frequency of the various forms differs considerably from those collected by Weiss, who gives us the following statistics: Ileocæcal, 43; iliac, 23; ileocolic, 14; colic, 26."

Volvulus. -Volvulus is either simple or compound (see "Medical Chronicle," February, 1903)—simple, when a coil of intestine is twisted around its mesenteric axis, compound, when two coils are mutually intertwined. The sigmoid flexure is most commonly affected, but the ileum, jejunum, or cæcum may also be separately or conjointly involved. In the majority of cases some anatomical abnormality is the determining factor a mesosigmoid of undue length, with a narrow base; the cæcum and ascending colon suspended by a mesentery continuous with the mesentery of the small intestine. The coil involved in the twist may become enormously distended. The sigmoid flexure, for example, may fill the whole abdomen and press the diaphragm up to the level of the fourth rib (Kuttner's case). The ease or difficulty of reduction of a volvulus will depend in great measure upon the degree of distension. If a short loop of the intestine alone be involved, uncoiling is generally easy, but if the sigmoid be grossly distended, the untwisting may be a physical impossibility, or the gut, when untwisted, may at once spring back into the former condition.

Volvulus shews a decided tendency to recurrence. This is due to the fact, already mentioned, that its onset is to be attributed to some mechanical abnormality in the disposition of the gut or of the mesentery. When, in such circumstances, a volvulus has occurred, the untwisting of the bowel does nothing to remove the disposing conditions. The bowel, in fact, is rather more likely than it was before to undergo a twist. Something more, therefore, may have to be done in an attempt to prevent a recurrence—and in certain cases even resection of the involved loop may be necessary.

When the abdomen has been opened and a volvulus found, it is brought outside the wound and its position and extent determined. If readily untwisted and the gut in fair condition, the bowel may be returned forthwith. If, however, the case is of long standing, an enormous distension of the coil may be found, and unravelling may be impossible until the bowel has been incised and its contents evacuated. This is the desirable course in many, if not in all, instances, for the emptying of the gut allows of easy reposition of the bowels, lessens the likelihood of septic absorption from the distension ulcers of the gut, and permits an early restoration of the peristaltic movements of the intestine. In some instances the overdistended loop may be emptied into the bowel below by gentle squeezing. In the case of the sigmoid flexure this may well be done. The sphincter is stretched first, and the contents, gas and abundant liquid fæces from the sigmoid and the higher colon, may be pressed out of the rectum. In a few cases the condition of the involved loop may leave the surgeon in doubt as to its vitality. If so, a Paul's tube may be inserted into the gut, or the loop may be placed immediately beneath the abdominal wound and a drainage-tube or ample gauze packing passed down to the gut. In one such case the volvulus, a coil of bowel twelve inches in length, was picked out as a slough from the wound, and the fæcal fistula which resulted was closed by a later operation ("Lancet," February 18, 1899, p. 430).

If the involved loop be actually in a state of gangrene, or if the volvulus prove to be due to a mesenteric growth which is perhaps malignant in nature, or if there be many adhesions to the loop and the bowel become lacerated in separating them, an excision of the affected gut should be performed. In these cases of mesenteric growth which have been recorded the removal of a large segment of the bowel has been necessary, for the growth may extend far back to the root of the mesentery, and the intestine, supplied by the vessels passing through a narrow area there, may be several feet in length. This is, of course, obvious if one remembers that the posterior attachment of the mesentery measures only six inches from the commencement, at the duodenojejunal angle, to the termination in the right iliac fossa, whereas the length of intestine to which the mesentery runs is over twenty feet. After enterectomy has been performed, the divided ends of the bowel should be forthwith united. Schlange has reported the successful removal of 135 cm. of gangrenous ileum forming a volvulus.

After the untwisting of a volvulus there may be, as I have said, a marked tendency to recoiling: the bowel may seem to spring back at once into its former twisted position. This tendency is decidedly lessened by the emptying of the gut, but even after this, it may be manifest and uncontrollable. In such cases it has been suggested by Braun that the loop should be stitched to the anterior abdominal wall, or, in the case of the sigmoid, that the ends of the loop should be sutured to the iliac fossa and the side of the pelvis. In this way not only may the immediate retwisting be prevented, but also the tendency to later recurrence, which has occasionally been experienced. In all instances of chronic or recurring volvulus it is probable that excision of the implicated loop will prove the most satisfactory treatment.

Senn has suggested, and in two cases successfully adopted, the practice of shortening the mesentery for the purpose of preventing a recurrence of the twist. "Shortening of the mesen-

tery," he writes, "can be effected by folding the mesentery upon itself in a direction parallel to the bowel, and suturing the apex of the fold to the root of the mesentery." In this way a pleat is formed in the mesentery without interfering with the blood-supply of the bowel.

In all operations for volvulus it must be borne in mind that a mere reposition of the twisted loop will not suffice to remove the abnormal anatomical condition upon which the volvulus depends. After uncoiling the twist an examination must be made to elicit the cause of the displacement. An attempt at the removal of this determining cause is in all cases desirable.

The following cases of volvulus have been under my care:

CASE 1. *Volvulus of the ileum associated with mesenteric cyst; untwisting; excision of the cyst; recovery.*

M. R., æt. eighteen, female. When first seen by me she was suffering from symptoms of intestinal obstruction. The following history was obtained: Nine days ago the patient went to an evening party and ate a "great many nuts." During the following night she woke with severe abdominal pains and vomited twice. Eight days ago she still had some slight abdominal discomfort, but from that day until three days ago she was comparatively well. On this latter day a slight bulging was noticed in the right iliac region. Pain, tenderness, vomiting, and complete constipation were present, and gradual increase in the size of the swelling was noticed. A few hours before I saw her the severity of the symptoms had swiftly increased. On examining the abdomen I found a little distension and slight tenderness everywhere. To the right of the umbilicus was a slightly movable lump, the size of an orange. This was dull on percussion, had a fairly well-defined edge, and was very tender. On opening the abdomen I found a cyst, of the size described, in the mesentery of the twisted lower ileum. I removed it and stitched the opposing layers of peritoneum at the base together, folding the edge over, so that the peritoneal surfaces were apposed. The volvulus was untwisted and recovery was uneventful.

CASE 2.—*Volvulus of the ileum; large hæmatoma of mesentery, simulating new-growth; enterectomy; death.*

Mrs. B., æt. sixty. Seen with Dr. Mason, Gomersal. For several weeks the patient had noticed an increasing discomfort in the abdomen, and had been subject to attacks of pain and constipation. About a month before being taken ill she had felt a "lump" in the body, at the lower part. There had been no vomiting, and food had been well taken, but some loss of flesh had been observed. Menses had ceased twelve years before, and there had been no vaginal discharge of any kind since the menopause. On January 25 there was an acute attack of abdominal pain, of greatest intensity in the hypogastric region. The pain was very severe, and caused some collapse and a sharp attack of vomiting. There was no action of the bowels after this attack, and vomiting was observed on several occasions, and always after any food or drink had been taken. The abdomen had become rapidly distended. On examination by me on January 29 the patient looked very ill, the temperature was 98.2°, the pulse 112. The skin was cold and there was decided collapse. Vomiting was severe and persistent, and hiccough had been observed during the few hours before my visit. On palpation of the abdomen a central tumour, equal in size to an adult head, was felt. It was tense, hard, and very tender. It was only slightly movable, and on vaginal examination was found to occupy the upper part of the pelvis, but to be free from the uterus. Nothing abnormal was felt on rectal examination. There was free fluid in the peritoneal cavity. A diagnosis of ovarian tumour with a twisted pedicle was made, and the patient was at once sent into a nursing home for operation. The abdomen was opened in the middle line between the umbilicus and the pubes. Immediately on opening the abdomen a serosanguineous fluid escaped from the peritoneum; and on introducing the finger a dense, hard, slightly nodular tumour was found. There were some loose, lately formed adhesions to the omentum and small intestine. On separating these the tumour could be delivered through the wound. The loop of gut, in whose mesentery it grew, was twisted round an axis at right angles to the bowel through one and a half turns, so that a volvulus, with a very tightly twisted pedicle, was formed. It was not safe to return the growth, on account of the hæmorrhage from the surface, which was freer after uncoiling of the twist.

Removal of the whole segment of the bowel was therefore determined upon. The growth and 73 inches of involved small intestine were removed, and end-to-end suture performed. The patient rallied well from the operation; but on the second day an acute attack of bronchitis supervened, and ended fatally on the fourth day. The gut had healed well, and no secondary abdominal growths were found. On examination the tumour was found by Dr. Cairns Forsyth to be composed entirely of blood.

CASE 3.—*Volvulus of the sigmoid; untwisting; enterotomy; recovery.*

Mrs. M., æt. thirty-six. Seen July 23, 1900, in consultation with Dr. Norman Porritt and Dr. Webster. On July 20 the bowels were moved naturally. Soon after this act an intense pain was suddenly experienced in the abdomen, most marked in the umbilical region. Vomiting followed soon and was copious and persistent. The abdomen rapidly distended, and absolute constipation was present. On examination of the abdomen one large coil was seen, of a horse-shoe shape, with the convexity towards the hepatic region. The respirations were very shallow and rapid; the pulse was 122. The abdomen was opened in the middle line, and an enormously distended sigmoid was found. The gut was opened and emptied, and there was then revealed a twist at the base of the sigmoid to rather more than a complete turn. The gut was untwisted and replaced, and the abdomen closed. A good recovery followed.

CASE 4.—*Recurring volvulus of the sigmoid; excision of the sigmoid flexure; recovery.*

F. L., male, æt. twenty-one, was admitted to the Leeds General Infirmary, under the care of Mr. Ward, on September 16, 1899, suffering from intestinal obstruction.

First Attack.—Down to a month before admission he had been quite well. He was suddenly seized with abdominal pain, not very severe or prolonged, and sickness. From that time up to admission he had been absolutely constipated; neither flatus nor fæces had passed for one month. The abdomen gradually enlarged, and on admission was greatly distended. Ten days before admission he vomited, and almost every day since he has vomited more or less. Pain had become gradually more severe. Enemata of oil, turpentine and water, and soap and water had been given without any effect.

First Operation (by Mr. Ward). —The abdomen was opened on September 17, 1899. A median incision was made below the umbilicus, and a condition of volvulus of the sigmoid flexure was found. The coil was untwisted, and the patient being placed in the lithotomy position and the sphincter stretched, the sigmoid and colon were partially emptied. The apex of the loop of the sigmoid was stitched to the middle line to prevent retwisting.

Second Operation (by Mr. Ward). —On September 19, as neither fæces nor flatus had passed, the sigmoid was opened in the middle line and an artificial anus established. On October 10 the bowels acted naturally for the first time, and subsequently the abdominal wound gradually closed, the bowels were moved regularly and naturally, and the patient left the infirmary on November 4.

Recurrence. —On September 3, 1901, the patient was sent to me by Dr. Waugh, of Skipton, on account of a recurrence of the intestinal obstruction. There had been some slight difficulty in getting the bowels opened for several months; this difficulty had become acute about a month earlier. He was confident in his statement that neither fæces nor flatus had passed for one month before.

Operation. —On examination he looked sallow and earthy in tinge. The abdomen was moderately distended. There was no localised bulging or any coiling. Nothing abnormal could be felt on rectal examination. The patient said that he had vomited a few times during the previous week, but he had continued to take food. I opened the abdomen on September 5, 1901, and found the following condition: The apex of the sigmoid flexure was adherent at the middle line. On separating it the sigmoid was opened; the opening was at once closed by suture. It was then seen that the upper part of the sigmoid loop — that portion between the end of the descending colon and the part of the loop adherent to the anterior abdominal wall — had become enormously distended, and had fallen into the pelvis of the lower portion of the loop. A kink had thus been produced in the gut at the upper part of the abdominal incision. When the heavy, hugely distended upper part of the sigmoid was lifted out of the pelvis, the lower portion of the loop was seen; this was quite empty. The ends of the loop — that is, the end of the descending

colon and the beginning of the rectum were very much nearer together than in the normal condition. The base of the sigmoid loop was approximately 1½ to 2 inches in length. I therefore decided to remove the whole sigmoid. The upper end of the rectum and the descending colon were clamped with my stomach clamps, the sigmoid arteries ligated, and the whole loop removed. The cut ends of the bowel were closed by simple suture, applied after the method I always adopt—a continuous suture for the peritoneum and muscular coats outside and a continuous suture taking all the coats (to act as a hæmostatic) within. The abdomen was then closed without drainage. The patient made a perfectly uneventful recovery and is now (April, 1903) quite well.

CASE 5.—*Compound volvulus of ileum and sigmoid flexure; untwisting; death.*

Mr. N. M., æt. 24. Seen in consultation with Dr. Hebblethwaite and Dr. Berry, of Keighley. For some weeks before this illness the patient had not been in his usual good health. He had given up active exercises, of which he was very fond, had ceased to ride horseback and to cycle, and had been capricious in his appetite. Three days before I saw him he complained of great abdominal pain, chiefly in the lower part of the abdomen, and nausea and occasional vomiting were present. When seen by Dr. Hebblethwaite his temperature was 100.6°, his pulse 110, he looked ill, and was obviously in great pain. The abdomen was distended everywhere and was a little tender. The bowels had not acted, but a little flatus had passed in response to an enema. On the subsequent day there was slight improvement in all the symptoms, but the condition gradually got worse and during the twelve hours before my visit there was an acute exacerbation of all the symptoms.

When I saw him his face was pinched and anxious, the skin cold, the breathing rapid and shallow, and the pulse 136, of feeble character. The abdomen was uniformly and tightly distended. Palpation caused pain, which was chiefly elicited in the lower part of the abdomen, but not especially on either side. The abdomen was motionless on respiration. A rectal examination revealed only a sense of pressure upon the anterior wall of the bowel. Intestinal occlusion had been absolute for over forty-eight hours. I diagnosed an acute general peritonitis, and sug-

gested, as the most likely explanation, the rupture of an acute exudation around the appendix into the general peritoneal cavity.

The abdomen was opened at once. The peritoneum was everywhere acutely inflamed, and there was blood-stained fluid free in the peritoneal cavity. A careful examination disclosed the fact that there was a volvulus of the sigmoid flexure, around which, as an axis, a loop of the ileum had been wrapped. The point of crossing was near the base of the sigmoid. There was therefore an intertwining of two loops—one in the sigmoid and one in the ileum. For this condition I have suggested ("Medical Chronicle," February, 1903) the name "compound volvulus." The loops were freed as speedily as possible, replaced, and the abdomen closed. The patient rallied from the operation better than might have been expected, but the following day hæmatemesis set in and he died on the third day.

Intestinal Obstruction due to Gall-stones. Gall-stones which cause acute obstruction pass from the gall-bladder into the intestine by ulceration. There are only two exceptions to this —one recorded by Abercrombie, the other by Lynn Thomas (see "Medical Chronicle," August, 1903). The small intestine, from the duodenojejunal flexure to the ileocæcal valve, is funnel-shaped, narrowing by degrees. A stone which will readily pass down the jejunum may, therefore, become blocked in the ileum. Cases of gall-stone obstruction of the pylorus and duodenum are recorded.

The narrowest part of the bowel from the pylorus to the anus is at the ileocæcal valve. The valve may cause the arrest of a stone or may be ruptured or damaged by its passage. Thus Maclagan ("Trans. Clin. Soc.," vol. xxl, p. 87) records a case in which a woman, after four attacks of intestinal obstruction, passed spontaneously four large gall-stones, each one inch in diameter, and at the postmortem only the fringes of the ileocæcal valve remained. It would appear that the gall-stone may, by the irritation of its rough surface, induce a spasm of the bowel and thus cause intestinal blocking, for Duplay and Reclus state that on postmortem examination the stone has

often been found lying quite loose in the flaccid intestine. Israel has recorded a case of obturation due to a gall-stone whose largest diameter was barely ¾ inch; muscular spasm was considered a potent factor causing the obstruction. The conditions present in a case of gall-stone ileus differ from those present in most cases of intestinal obstruction. There is a block in the lumen of the bowel, but there is no interference with the circulation. The experiments of Kader have shewn clearly that the intensity and severity of the symptoms of strangulation are in no small measure due to the interference with the vascular supply of the involved loop. In gall-stone ileus we have to reckon only with a plugging of the lumen.

In operations for obstruction due to a gall-stone the cæcum will, as usual, be sought when the abdomen is opened, and it will be found collapsed. The empty gut is rapidly passed through the fingers until the gut is met. In one case upon which I operated, and in others recorded in the literature, the coil of bowel containing the stone has presented in the wound at the moment when the peritoneum is incised. The loop containing the stone is then withdrawn from the abdomen, clamped above and below, or nipped by an assistant's fingers. The stone is then removed by an incision down on to it through the intestinal wall, the cut being of such length as the size of the stone demands. If the bowel below the stone be very empty and narrow, the stone may be displaced upwards two or three inches into a distended portion of the gut, to make the subsequent suture of the bowel easier. The stone being extracted, the incision is stitched by two layers of continuous sutures, the bowel cleansed and replaced, and the operation completed in the usual manner.

C. L. Gibson, in a study of 646 cases of intestinal obstruction, recorded between 1888 and 1898, found that 40 were due to gall-stones ("Annals of Surgery," October, 1900, p. 506); of the 40 cases, 21 died. There were 9 males and 27 females—in the remainder the sex is not mentioned. The youngest pa-

tient was thirty-five years of age; only 7 patients were under fifty, and 8 were seventy years or over.

The obstruction was only once found below the ileocæcal valve; once the stone was impacted in the valve. In 21 cases the history distinctly states the site of its arrest as the ileum, in 2 as the jejunum, and in 1 at the junction of jejunum and ileum.

There was a clear history of gall-stones in 18 cases; in 5 cases it is distinctly stated that there had never been any suspicion of cholelithiasis. The largest stone weighed 3½ ounces.

There can be no doubt that obstruction caused by a gall-stone is the simplest form with which the surgeon can meet. The block affects only the lumen of the bowel and causes no interference with the vascular supply of the gut. The results of operations are, however, not so satisfactory as could be wished. The cause of this is the usual one—delay. In not a few cases of obstruction due to a gall-stone the patient, when desperately ill, or even, as in one case, moribund, has recovered after the passing of the stone. It has, therefore, become the practice, accepted and authorised by the best writers, to postpone any surgical treatment until other measures have been tried and failed. Then when death is imminent, an operation is sanctioned. Here, as in all forms of obstruction, it is early operation alone which can remove the reproach that belongs to the treatment of this disease.

CHAPTER XXVIII.

EMBOLISM AND THROMBOSIS OF THE VESSELS OF THE MESENTERY.

THE occurrence of occlusion of the vessels of the mesentery by pathological processes was first described in 1847 by Virchow. The clinical manifestations were considered in a paper by Litten in 1875. During the last few years a large number of cases have been described, and in a series of papers in the "Journal of the American Medical Association" (vol. i, 1904, p. 1469; vol. ii, 1904, pp. 29, 110, and 183) Drs. Jackson, Porter, and Quinby have analysed the records of 214 cases.

It is a remarkable but an undoubted fact that in occlusion of the mesenteric arteries the collateral circulation is very rarely established. The anastomosing vessels are of small size, and do not effect more than the carrying of blood in the smallest quantities to the impoverished area. The result is that this area becomes by slow degrees overloaded with blood, which is brought slowly to it but cannot escape from it; diapedesis occurs, and a hæmorrhagic infarction is established. Faber (quoted by Dr. Jackson) explains the infarction as being due to "back pressure of blood in the portal system, which overcomes and is greater than the pressure in the anastomosing vessels. The reason why the inferior mesenteric artery does not take up the work of the closed superior artery he explains by saying that it is a smaller vessel and cannot suddenly assume the functions of a larger one. Further, after closure of the superior mesenteric artery the pressure in the superior mesenteric vein necessarily sinks to *nil* immediately. The pressure in the portal system is thus lowered, making the flow from the inferior mesenteric vein easier. It is thus easier for blood in the inferior mesenteric artery to flow by its natural channel."

In some few cases, nevertheless, the evidence of the complete establishment of the collateral circulation is unmistakable. Chiene ("Jour. Anat. and Phys.," 1868, part iii, p. 65) describes a condition met with in the postmortem room which leaves no doubt upon this point. The cœliac axis was represented by a fibrous cord, the clear result of an old embolism. The upper portions of the mesenteric arteries were obliterated, yet the branches of both were filled with injection material. The collateral circulation had been established through the left and middle colic vessels. The plexus of arteries behind the peritoneum was much dilated, and formed a communication between the internal iliac artery and the arteries of the mesentery. Karcher records the case of a patient who lived at least two months after the superior mesenteric artery had been blocked. Similar instances are mentioned by Cohn, Virchow (two cases), and others. It is possible that in these cases the occlusion was very slow in formation, and that the collateral circulation had meanwhile become established.

The results which follow closure of the superior mesenteric artery alone, of the vein alone, or of both simultaneously, are identical. This has been shewn by postmortem investigation and also by experimental work conducted by Cohnheim.

As soon as the blood-supply of the intestine is interfered with, the wall of the bowel becomes readily and rapidly invaded by microorganisms, and putrefactive processes, ending in gangrene, are begun. The appearances presented by the bowel vary much according to the time that has elapsed. If the vessel or vessels be ligated, the first change that is apparent in the walls of the gut is that they are flaccid and anæmic; gradually they deepen in colour and become at last deep purple or black. The mesentery becomes turgid and thickened, and by slow degrees there occurs a distension of the implicated bowel.

The causes of the embolism or thrombosis are numerous. In the great majority of the cases of embolism there is endocarditis, and it is from the diseased valves that the fragment

which plugs the vessel is detached. Gallavardin asserts that the cardiac affection which is most commonly present is mitral stenosis. Atheroma of the mesenteric arteries has occasionally been found.

In cases of venous thrombosis the thrombus may be primary or secondary; it may originate in the vessel or may be secondary to portal thrombosis. Primary thrombosis has followed upon acute or chronic enteritis, upon the infection of a wound, upon the occurrence of intra-abdominal suppuration—as, for example, in inflammation of the appendix or Fallopian tubes. Secondary thrombosis has occurred as the result of cirrhosis of the liver, pylephlebitis, and syphilis. The extent of the necrosis or gangrene of the intestinal wall varies within the widest limits—in some cases there is no more than a narrow annular slough; in others many feet of the bowel are involved.

SYMPTOMS.

The symptoms vary greatly in different cases. There are two groups of cases, the acute and the chronic, of which the former is the larger.

In the acute cases the symptoms are ushered in with absolute abruptness at a time when the patient is in good health. There is a sudden, intense, abdominal pain, at first colicky in character, later becoming almost unremitting, which is speedily followed by nausea, vomiting, and perhaps collapse. There may be diarrhœa or constipation: if the former, the motions are frequent and blood-stained; if the latter, obstruction is absolute, neither flatus nor fæces being passed. In both, the abdomen becomes distended, rigid, and tender. There are occasionally the signs of free fluid in the peritoneum. The general condition of the patient is poor from the first and rapidly becomes worse. The temperature is often subnormal. The pulse is always rapid, and its quality is bad. Blood-stained motions are found in 41 per cent. of the cases, but even when

no blood has been passed, the intestinal contents are always found to be deeply blood-stained.

The second smaller group is formed by cases of quiet, insidious origin, with a prolonged and varying course. Jackson and others have shewn that the belief that the acute cases were dependent upon embolism and the chronic upon thrombosis is fallacious. In the series of cases collected by Jackson, Porter, and Quinby there were 7 marked chronic cases dependent upon thrombosis and 7 dependent upon embolism.

The cases are almost twice as common in men as in women, and the majority are found between the ages of thirty and sixty years.

There is always the greatest doubt as to the nature of the illness from which the patient suffers. A diagnosis of intestinal obstruction is generally made, and it is only at the operation or at an autopsy that the exact condition of affairs is revealed.

Gerhardt considers the following signs as necessary to the making of a diagnosis:

1. The presence of a source for an embolus.
2. Copious intestinal hæmorrhages, not to be explained by disease of the wall of the bowel or by impediment to the portal circulation.
3. A rapid and marked fall of temperature.
4. Colicky pains in the abdomen.
5. The simultaneous or previous occurrences of embolism in other parts. Falk collected the records of 17 cases of embolism of the superior mesenteric artery; in every one there was evidence of embolism having occurred elsewhere.
6. The occasional presence of a tumour in the abdomen, due to the infiltration of the mesentery by blood.

Not all of these signs are present in any cases, but the existence of some of them is necessary to the making of a diagnosis.

J. Amos ("Zeitschrift f. Geb. u. Gyn.," Bd. 55), in recording

two cases of thrombosis of the superior mesenteric vein, reviews the whole literature of the subject and concludes that in a case where the symptoms are those of intestinal obstruction, one should think of superior mesenteric vein thrombosis if (*a*) there are present any conditions favouring an increased rate of coagulation of the blood, such as pregnancy, eclampsia, and thrombosis of veins elsewhere; (*b*) there be stagnation in the portal circulation; (*c*) there have been any artificial thrombus formation (as, for example, after operation) in the vicinity of the affected vessels; (*d*) there have been any purulent processes in the areas drained by the radicles of the portal system.

The **prognosis** is bad. The mortality in reported cases is 94 per cent. Neutra, quoted by Jackson, Porter, and Quinby, writes:

"In cases of acute onset the prognosis is indeed very grave, but by no means absolutely bad, since behind these severe symptoms there may be hidden a chronic process which favors the formation of a collateral circulation, and on this the prognosis depends. If, on the other hand, the course is a chronic one and only a few exacerbations are present, between which there is complete absence of symptoms, the prognosis, nevertheless, is moderately bad, since in these cases it must be assumed that because of some hindrance a competent collateral circulation cannot be formed. Accordingly, thrombosis of mesenteric arteries is of relatively better prognosis than embolus."

TREATMENT.

In the surgical treatment of these most serious cases the first and most essential point to remember is that the gangrene of the bowel may be in a state of progression. A well-defined line of demarcation between the healthy and the involved may be seen, but more often there is no abrupt transition from one to the other. Unless, therefore, a needlessly extensive resection is made, it is impossible in all cases to be certain that the whole of the involved loop of bowel has been removed.

It is, accordingly, reasonable to suppose that the safest measure to adopt in all cases is the resection of the bowel which is undoubtedly involved and the establishment of an artificial anus. If an end-to-end anastomosis is completed, a subsequent extension of the process of gangrene may cause an otherwise satisfactory operation to fail. Moreover, the patients who suffer from this affection are often seriously ill, and an extensive removal of the bowel with the suturing of the cut ends together will occupy so much time, and will involve so much handling of the parts, that the strain may be beyond the patient's endurance. In the cases quoted by Jackson there were 47 which were dealt with by operation. Of these, 4 recovered. This deplorable result is probably due to the performance of an operation unsuited to the patient's condition.

The case, as I have said, will probably be considered as one of acute intestinal obstruction, and will be submitted to operation for the relief of that condition. All the measures of precaution that have been described before will be adopted in order to shorten the operation and to prevent the occurrence of shock.

When the abdomen is opened, there is generally an escape of fluid which is more or less blood-stained and may be offensive. The fluid resembles very closely that which we are accustomed to see in the sac of a long strangulated hernia. A rapid but careful examination of the intestine will reveal the exact condition of affairs. A deeply congested purple segment of gut will be found, and there will be no evidence of mechanical constriction or of volvulus to account for the condition. The mesentery to the implicated bowel may be immensely thickened by blood-clot, so that a large tumour may be felt at once. The gangrenous gut is withdrawn from the abdomen, and the whole loop involved is resected in the usual manner. Clamps are applied well above and well below the disease; the bowel is divided, and with its mesentery the whole involved part is removed. The two cut ends of the bowel are then brought

out from the wound side by side, and their peritoneal surfaces stitched to the parietal wound; or a Paul's tube may be placed in each end; or the cut edges of the mesentery above and below may be approximated and a few sutures passed uniting the mesenteric portion of the bowel, the remainder of the circumference being left open and being brought up to the surface. In all cases drainage of the intestine must be ensured. The contents of the bowel resected will be seen to be deeply blood-stained, and a blood-stained discharge may flow from the artificial anus for several days after the operation. When the bowel has been secured to the abdominal wall, the parietal wound is closed as rapidly as possible.

If the operation prove successful, the patient will rapidly gain strength. A second operation for the closure of the fistula must then be performed as soon as it appears prudent to attempt it; for the fistula in the bowel may be high in the small intestine, and the discharge may be of an intensely irritating nature. The patient, then, suffers severely from inanition, as a result of the escape of food-material from the fistula.

CHAPTER XXIX.

OPERATIONS FOR FÆCAL FISTULA AND ARTIFICIAL ANUS.

OPENINGS between the intestine and the surface of the skin are of three kinds:

1. A small opening upon the skin leads by a direct or tortuous path to an opening in the bowel. There is, that is to say, a fistulous tract between the skin-surface and the gut (Fig. 193).

2. A larger opening in the intestine has an edge formed by the direct continuation of the mucosa with the skin. Such a condition would result from making an incision into a portion of the bowel and stitching the edges to the skin-margin. At the bottom of this opening can be seen the mucosa of the opposite side of the bowel, and a finger passed into the opening can be made to pass in two directions—upwards and downwards; there is no spur and no prolapse (Fig. 194).

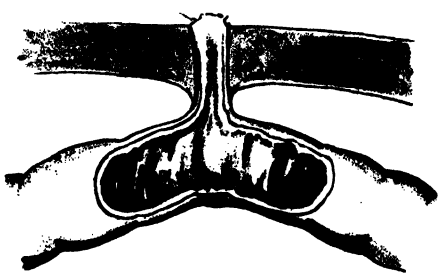


Fig. 193.—Fæcal fistula.

3. The intestine, as it comes to the surface, has two limbs which join at an acute angle. A well-marked spur is formed. On the proximal side of this the bowel is wide and readily admits the finger. On the distal side the bowel is narrowed from disuse. All the intestinal contents coming downwards escape at this artificial anus; none, or very little, passes over the spur into the distal segment. The spur is approximately on a level with the skin (Fig. 195).

The closure of a fæcal fistula is accomplished with ease or with difficulty, according as there is an abundant or a deficient supply of peritoneum. If the wound in the bowel can be closed

in securely with a suture of the serous coat, its firm healing will undoubtedly follow. If no peritoneal investment can be obtained, the closure of the wound is problematical. It follows, therefore, that an opening into the small intestine or into the

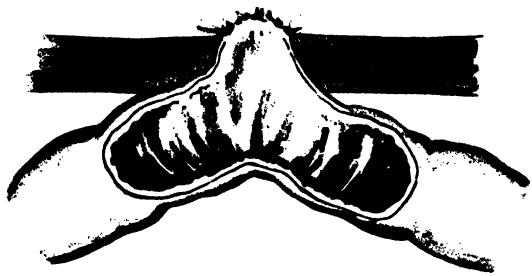


Fig. 194.—Artificial anus, without spur.

transverse colon or the sigmoid flexure (all of them completely clothed in peritoneum) is more easily dealt with than an opening into the ascending or descending colon, especially if the

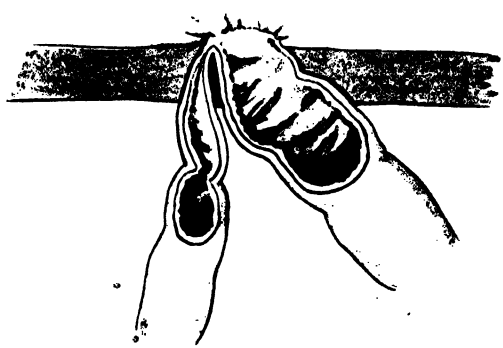


Fig. 195.—Artificial anus, with spur.

posterior surfaces, bare of peritoneum, are only or chiefly involved.

In all cases some considerable attention must be paid, perhaps for many days beforehand, to the preparation of the skin. The discharge, from the small intestine especially, has a most

irritating effect, producing a florid, intensely red, raw, excoriated appearance. Such a condition of skin often causes the patient intense misery. The intestinal contents escaping over it seem to scald, and by their irritant action to intensify the already grievous suffering of the patient. If the skin be constantly cleansed, kept dry, and covered with an ointment (the ung. zinci oleati in my experience is the best) thickly applied, some improvement of the condition may result. Prevention, however, is better than attempted cure, and it is, therefore, desirable that the skin should be protected from the time the opening into the bowel is made. This may be effected by covering the skin with some rubber dam (as used by Murphy) or by daubing the skin with a four per cent. solution of pure rubber in benzine or acetone. An impenetrable covering to the skin may thus be made, which can be washed off with benzine at any time. Plugging of the bowel, in order to prevent it emptying on to the skin, is generally ineffective. For twenty-four hours before the operation very little should be given by the mouth, so that peristalsis is not excited. The precautions suggested by Harvey Cushing, to which reference has already been made, are carefully observed.



Fig. 196.—Fæcal fistula. Lines of skin incision.

1. In cases where a fæcal fistula of the first type mentioned is present, the following operation will be found the most satisfactory:

An elliptical incision is made through the skin at some little distance from the margins of the skin opening. The skin-edges are always unhealthy, sodden, and eczematous, and their free removal is desirable. The incision is carried through the skin, subcutaneous tissues, and muscular layer of the abdominal wall until the peritoneum is reached. If there is any fear

of leakage from the fistula, the cut edges of the skin surrounding may be turned over and sutured very tightly together with a running stitch of stout thread, so as to cause accurate apposition and prevent leakage. It is better to do this than to plug the bowel with wool or gauze which will have to be removed at a later stage of the operation. The peritoneum is then opened with care, for adhesions of those parts of the bowel below the fistula to the abdominal wall are not infrequent. When the peritoneum is freely opened, the loop of bowel is withdrawn. With it will be the ellipse of skin surrounding the fistula and the fistulous tract. The bowel is surrounded by moist gauze swabs and is held by a single clamp, which prevents hæmorrhage and leakage. A pair of scissors now snips through the gut at the margins of the fistula, so that an oval opening is made, and the fistulous tract, skin, etc., are removed. The opening into the bowel will be found to be of small size, and generally in the longitudinal axis of the gut. This opening is now sutured, at right angles to the axis of the gut, with a double layer of sutures, one embracing all the coats, the outer picking up the seromuscular coats only. The clamp is removed, the parts thoroughly cleansed, and the gut returned within the abdomen. Over it the omentum, if accessible, is care-



Fig. 107.—Fæcal fistula. The dotted line shows the portion of bowel removed.



Fig. 108.—Fæcal fistula dissected out (after Treves).

fully laid. The parietal wound is now closed, after further trimming, if such be necessary.

2. In the second variety of intestinal fistula the following operation may be practised. An elliptical incision around the mucous margin of the opening is made and deepened until the adherent wall of the bowel is met with. The adhesions of the gut to the surface are then gently separated, and the bowel isolated and the peritoneum protected as before. The clamp is applied for the controlling of the blood-supply in the bowel and to prevent the escape of intestinal contents. The margins of the fistula are trimmed, and the size of the gap in the intestinal wall can then be seen. It will be found that the loss of substance chiefly involves the portion of the bowel most distant from the mesentery, the mesenteric border being almost always quite intact. Even after a considerable loss of substance an end-to-end approximation of the gut may be made, the strip of the bowel-wall along the mesenteric border being allowed to remain. It is rarely necessary in this form of fæcal fistula to do more than trim freely the edges of the intestinal opening and afterwards to suture the opening transversely to the long axis of the intestine. The intestine is then found to be bent upon itself at an angle, the apex of which is at the mesenteric margin of that strip of the wall of the gut which was not removed. Two continuous sutures are used to close the opening—an inner, which

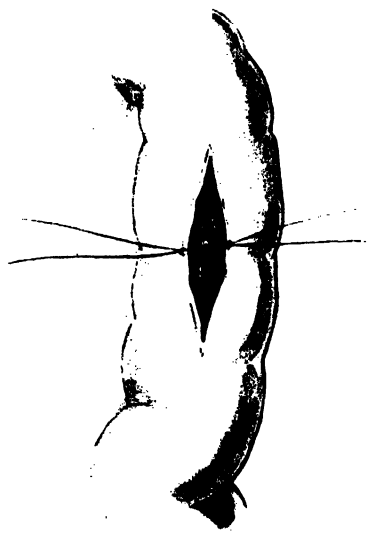


Fig. 109.—The fistulous tract is excised and the wound is drawn open transversely.

includes all the layers, and an outer, which includes only the seromuscular coats.

When the loss of substance is considerable, this method of operating is not possible. Under such circumstances a complete resection of the involved segment of the bowel, followed by end-to-end union, must be performed.

3. In the third form of fistula, that in which an artificial anus, with the formation of a spur, is found, a resection of the involved portion of the gut is generally necessary.

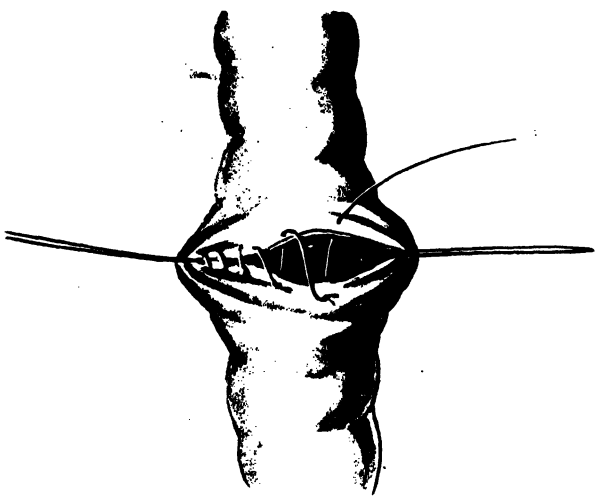


Fig. 200.—The opening in the bowel closed in the manner shewn.

In some instances, however, as in cases of Paul's operation, previously described, and in cases of colotomy, or of fæcal fistula, following upon strangulated hernia, it is possible to destroy the spur and to convert the abnormal opening in that manner into a fistula of the second class, which can be closed by the paring of the edges and suture. The destruction of the spur, or its obliteration, may be effected in one of two ways: When the spur is slight, the suggestion of Sir Mitchell Banks may be adopted. This distinguished surgeon introduced a piece

of thick rubber tubing into the bowel, pushing one end of the tube into the upper end and the other into the lower end of the bowel. The tube, being elastic, tended to straighten itself, and in so doing exerted a continuous pressure upon the spur, which was gradually borne down. The tube was secured by a long silk thread.

A more effective method of dealing with the spur is that in



Fig. 201.—Fæcal fistula necessitating enterectomy.

which an instrument of the type of Dupuytren's enterotome is used. This instrument consists of a pair of forceps with long, roughly serrated blades which are pressed together and held by a clip or a screw in the handle. One blade of the forceps is introduced into the upper opening and another into the lower opening, so that when the blades are closed, the spur is grasped between them. The pressure of the blades is tightened daily

until the spur is destroyed. An ordinary pair of broad clips acts quite as efficiently as the specially devised instrument.

When the spur is destroyed and the lumen of the proximal and distal segment of the gut is again patent, the fæcal current is restored, and a spontaneous closure, or closure by the method of partial resection just described, may be effected.

Failing these, the only satisfactory method is resection of the bowel involved in the fistula.

In performing the operation of resection the preliminary stages are the same as those already described. An oval incision through the skin, rather wide of the opening, is made and deepened cautiously until the peritoneum is opened. The bowel is made free from all surrounding adhesions, withdrawn from the abdomen, and packed round with swabs. The gut to be excised is then clamped at each end, and the typical operation of resection, previously described, is performed.

In resection operations in cases of fæcal fistula, wherever situated, it is often a matter of some difficulty to free the bowel involved from the intricate complexity of adhesions by which it is surrounded. These adhesions affect more especially the distal segment of the gut—that which has been relieved of a portion of its function by the existence of the fistula. As a result of this relief the distal bowel is wasted, shrunken, and empty. The coils contract adhesions, one with another, and when an end-to-end anastomosis has to be performed, the disparity in size of the ends may be remarkable.

CHAPTER XXX.

OPERATIONS UPON THE APPENDIX.

1. REMOVAL OF THE APPENDIX.

THE removal of the appendix in the interval of quiescence which follows the last of a series of attacks was advocated in 1887 by Sir Frederick Treves. It is now more frequently performed than any other abdominal operation.

Position of the Appendix.—The appendix cannot be said to have any normal position. Its position, doubtless, changes in the individual from time to time. When a series of bodies are examined, the appendix may be found in any of the following positions:

(*a*) Lying with its tip pointing towards the spleen, being behind the termination of the ileum.

(*b*) Hanging over the brim of the pelvis.

(*c*) Lying in the iliac fossa, with its end near Poupart's ligament.

(*d*) Lying along the outer side of the ascending colon.

(*e*) Lying behind the cæcum and ascending colon in the retrocolic fossa.

The first two are the positions in which the appendix is most commonly found at operations. The place in which the appendix will be found can often be conjectured before the operation is commenced. If, during the acute attack, there has been the "symmetrical" pain,—pain, that is, over an area on the left side corresponding to McBurney's point on the right side,—the appendix will be found to hang over into the pelvis or to be adherent across the middle line. If there has been pain spreading upwards from the iliac fossa to the gall-bladder region or backward to the loin, the appendix will probably lie along the outer side of the colon.

Operation.—The abdomen is opened by an incision which does not divide the muscles, but splits them, each in the direction of its fibres. This incision was first suggested by McBurney ("Annals of Surgery," vol. xx, p. 38). The skin is divided along an oblique line about three to four inches in length which begins about an inch and a half above, and internal to, the anterior superior spine, and passes downwards and inwards. When the skin and subcutaneous tissues are divided, it will be seen that the line of the incision corresponds precisely with the line of direction of the fibres of the external oblique. These fibres are split by making a small cut through them, and then, with



Fig. 202.—McBurney's incision for removal of the appendix: *a*, Fibres of external oblique before the splitting; *b*, fibres of external oblique separated; a small incision made through fibres of internal oblique and transversalis near outer border of rectus; *c*, fibres of internal oblique and transversalis separated; peritoneum exposed.

the fingers, tearing them apart. The internal oblique and transversalis are now split in the direction of their fibres—that is, at almost a right angle with the fibres of the external oblique. This separation of the fibres of the two muscles is most easily effected by making a small incision through their common aponeurosis, just at the outer margin of the rectus muscle, and by enlarging this small cut by the introduction of a clip or the tip of a finger, and then gently pulling the fibres apart. The separation of the muscular bundles should be cleanly and neatly done and should leave them smooth and unfrayed. The fingers of an assistant or a couple of retractors are now placed in the

wound to drag apart the edges, and the peritoneum is seized with dissecting forceps and incised, an opening about 1½ to 2 inches being made. The surgeon now introduces his forefinger into the wound and searches for the cæcum and appendix, and the retractors are taken away.

In some cases more room than is afforded by this incision may be necessary. If so, the prolongation of it first suggested by Harrington may be found useful.

The following description of his method of incision is given by Francis B. Harrington ("Boston Med. and Surg. Journal," Aug., 1899, and March, 1905):

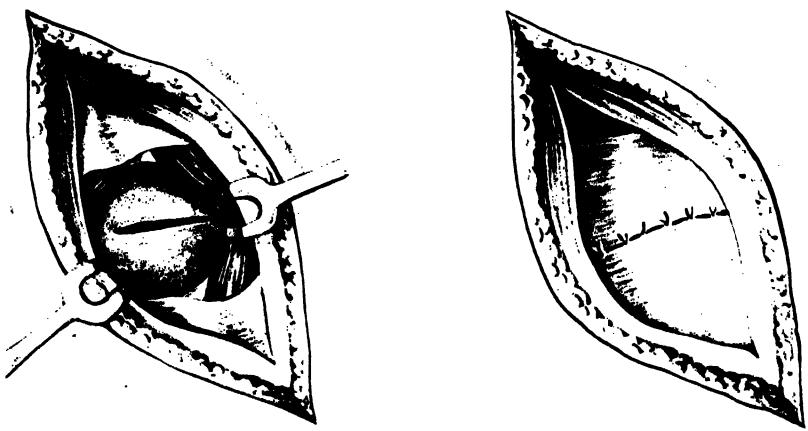


Fig. 203.—Harrington's incision for the removal of the appendix. The McBurney incision is made, and the sheath of the rectus afterwards opened, the rectus being drawn to the inner side. The method of closure of the wound is also shewn.

"Make an incision in the skin four to five inches long in a line with the fibres of the external rectus muscles, at such a distance from the anterior superior spine of the ilium as is desirable. Separate the muscle and its tendon without cutting for a like distance, then insert retractors one and a half inches broad at either end. The middle of the incision should correspond to the usual position of the base of the appendix. At this point the internal oblique and transversalis muscles run nearly parallel and horizontal. These muscles should be separated, without cutting down to the transversalis fascia, and

from the ilium to the linea semilunaris. If this does not give sufficient room, the sheath of the rectus may be separated in front and behind the muscle in a line continuous with the separation of the internal oblique and transversalis muscle.

"The sheath of the rectus muscle is formed by the aponeuroses of the internal oblique and transversalis muscles. The direction of the fibres of the sheath is horizontal, being at right angles to the line of muscular fibres of the rectus. At the semilunaris line it will be necessary to use the knife or scissors, since at this point the union of the various aponeuroses is very compact. The rectus muscle can then be drawn toward the linea alba, and considerable room obtained.

"Care should be taken not to cut the deep epigastric artery which at this point lies inside the rectus sheath in the posterior part of the muscle. If necessary, it may be tied. Two retractors, each about two inches broad, should be inserted, one at either end of the deep incision; the retractors which have been used for the external oblique can now be dispensed with."

The search for the appendix may be easy or may be supremely difficult. If the cæcum can be felt at once, it is hooked forwards into the wound, and the longitudinal muscular bundles are followed down upon it until the appendix is reached. It is important to remember that the longitudinal striæ of the ascending colon lead downwards to the appendix. They are not rarely the only landmark the surgeon may have. When the finger is first introduced into the abdomen, the appendix may be felt at once—may forthwith be pulled forwards to the wound. Or a small irregular swelling may be felt, which is recognised as the appendix involved in a mass of inflammatory exudate. If any stripping of dense adhesions has to be done, it is desirable to pack off the operation field by means of sterile gauze. This will secure that in case an infected area is opened up no septic matter can escape into the general peritoneal cavity. Adhesions, when present, are gradually separated without much difficulty, but in some cases the patience and skill of the surgeon may be tried to their utmost.

If the omentum is found to form a protecting hood over the appendix or to enclose it in a wrap, it should not be stripped away, but should be clipped, divided, and ligated at a little distance from the appendix. The latter, with the omentum around it, is then removed *en masse*.

In separating off the complex and firm adhesions of structures which are perhaps unrecognisable at the moment, the use of gauze will be found of great service. A single or double layer of sterile gauze is wrapped around the finger, and with gentle pressure the adhesions are, as it were, wiped away. It is a safe rule to keep near the appendix and to separate all other structures from it, not to detach the appendix from them. As much roughness as necessary may be displayed towards the appendix, but all other structures must be handled with the finest care. By rough or clumsy handling the ileum or the cæcum may be torn open. The appendix may have to be dislodged from the retrocolic fossa or to be shelled out from a snug retreat beneath the enteric mesentery. It may be intimately adherent to the ovary or the uterus, or it may be flattened against the wall of the pelvis. Whatever its position, and however unyielding its adhesions may prove to be, the stripping of it must continue until its tip is reached. The points to bear in mind are: to pack off the cavity of the abdomen with gauze or swabs; to strip *from* the appendix; to use gauze wrapped around the finger to facilitate the separation of adhesions, and to inflict damage and to exert traction only upon the appendix. In certain instances, when the separation has seemed unusually difficult, I have first freed the appendix from the cæcum (in the manner to be presently described) and then proceeded with the search for the tip of the appendix. This often makes matters very much easier; it is a point worth remembering when the difficulties are great.

Treves recommends the following plan in difficult cases: "In many cases of difficulty I have divided the undisturbed peritoneum of the right iliac fossa well to the outer side of the dis-

turbed area, and, by working along in the retroperitoneal tissue, have reached the adherent bowel and have readily detached it, stripping off the peritoneum with it." I have never found it necessary to do this. When the appendix is being disentangled from its many adhesions, an old abscess cavity may be discovered. The contents are generally dry and may resemble cream cheese; they are usually sterile. The cavity should be cleansed by gentle scraping, wiped repeatedly with sterile dry gauze, and finally washed out with a swab moistened in sterile salt solution. There is no need for drainage in such a case. I am generally content to pull the omentum over and to leave a tag of it within the cavity. If any pus be found, then, of course, drainage is imperative, but the dried remnant of pus is generally not infective.

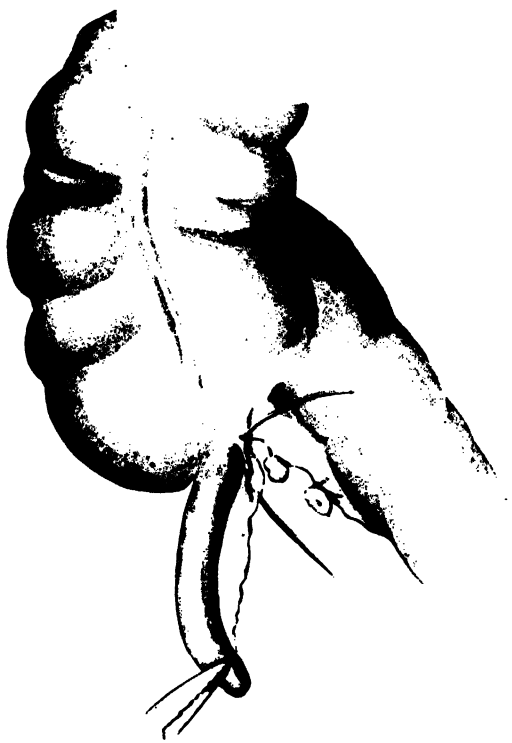


Fig. 204.—Removal of appendix. Ligation of mesoappendix.

When the appendix has been liberated, it is withdrawn, together with the adjacent part of the cæcum, from the abdomen, and surrounded by sterile moist gauze swabs. The appendix is then removed in the following manner:

The assistant wraps the appendix around with gauze or seizes the mesentery near the tip of the appendix with a clip, so as to expose the mesoappendix more readily. When the mesoappendix is displayed it will be found that there is a bloodless

area near its base. Between this area and the free edge of the mesoappendix runs the artery to the appendix. Through this bloodless spot a needle, armed with catgut, or, preferably with fine Pagenstecher, is passed. The ligature is then tied and the artery secured. The mesoappendix is then divided just beyond the ligature and the ligature cut short. There is now left a thin strip of the meso-



Fig. 205.—Removal of appendix (continued).

appendix in contact with the appendix, and this strip should be secured by passing the same needle through it exactly at the base of the appendix. In passing the needle it is desirable to pick up a few fibres of the muscular coat of the appendix, so as to make certain of securing a small vessel, which at this point lies closely in contact with the appendix. Two cases of death from hæmorrhage from this small vessel have been recorded. The strip



Fig. 206.—Removal of appendix (continued).

of the mesoappendix is then divided, and the appendix is now seized at its junction with the cæcum in a clip, which is tightly pressed home. On removing this clip it will be found that the mucosa has been pressed away and that only a ring of the serous coat remains. At this point a fine ligature is applied, and about ⅛ inch beyond this a clip is placed. The appendix is divided just distal to the ligature; the clip prevents any escape from the appendix. It is important to remove *all* the appendix. In cases related by Treves, and in one case upon which I operated, a portion the appendix, a stump ¾ or 1 inch in length, had been left behind by a former operator, and, owing to the presence of a stricture at the valve of Gerlach, the symptoms had persisted, unaltered, after the operation.



Fig. 207.—Removal of appendix (continued).

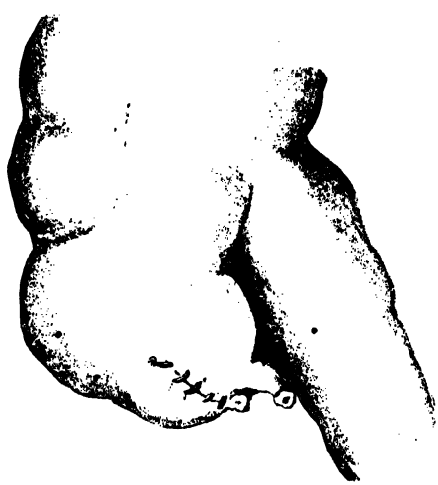


Fig. 208.—Removal of appendix (continued).

The ligature at the cæcum is now buried either by a purse-string suture or by a continuous Dupuytren suture of fine celluloid thread—preferably the latter. The stitch infolds about 1 inch in length of the cæcal wall; in the centre of the line of suture is the ligature, applied at the base of the appendix.

As a rule, it is desirable to put in two continuous sutures so as to make the sealing-off secure.

This is the operation as practised in the ordinary case. It may have to be modified to meet altered conditions in various cases. In one patient upon whom I operated the appendix had become very adherent to the cæcum near its junction with the ileum. On separating the adhesions the raw surface left behind had to be covered in by a continuous suture. As a



Fig. 209.—Removal of appendix; purse-string suture applied. This is afterwards buried by a continuous suture. There is no ligature around the base of the appendix.

result, a high degree of narrowing of the ileocæcal junction resulted, for which I performed a lateral anastomosis between the termination of the ileum and the cæcum.

It is important, as has been said, to ensure a complete removal of the appendix. Furthermore, all adhesions must be freely separated or divided, for adhesions may subsequently cause the symptoms of intestinal obstruction by contracting upon the ileum or the cæcum. In one patient I have had to operate a second time for these adhesions, which had greatly

narrowed the ileum about an inch above its termination. In this case I performed ileocolostomy, uniting the ileum to the ascending colon.

In some cases, especially in women, when a pelvic examination is necessary, or some operation upon the ovary also may be called for, Battle's incision may be used.

The following is Mr. Battle's description of his method (Bat-

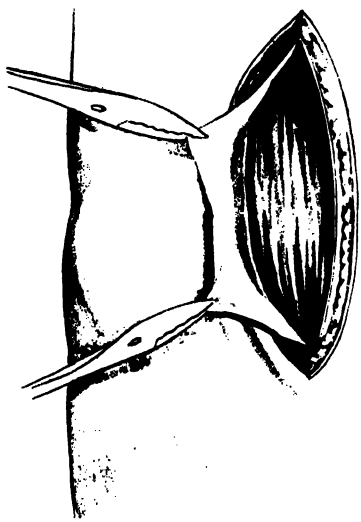


Fig. 210.—Removal of the appendix (Battle's method). The anterior sheath of the rectus incised, and the outer part stripped up from the front of the muscle.

tle and Corner, "The Surgery of the Diseases of the Appendix Vermiformis," p. 77):*

An incision is made through the skin and subcutaneous tissues down to the sheath of the rectus; this section is made obliquely downwards midway between the anterior superior iliac spine and the umbilicus, is about four inches in length, vary-

* This operation has been attributed to several other surgeons, but there can be no doubt whatever that Mr. Battle was the first to perform and to describe it.

ing with the deposit of fat in the abdominal wall of the individual, and is placed so that it is equally extended above and below this line. The outer margin of the rectus sheath can now be easily defined, and during inspiration the direction of the action of the external oblique aponeurosis seen. The inner margin of the wound is retracted about half an inch, and the anterior sheath of the rectus opened close to the retracted inner margin for the full extent of the incision. The rectus muscle

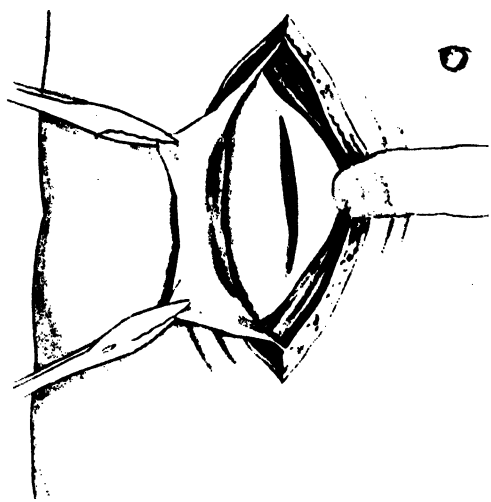


Fig. 211.—Removal of the appendix (Battle's method). The rectus muscle pulled inward. The posterior incision through the transversalis fascia and peritoneum is shewn.

is now drawn inwards, being separated from the outer part of the sheath with a few touches of the knife. Occasionally one of the lineæ transversæ requires to be separated from the sheath. Running across the posterior layer of the sheath can usually be seen the dorsal nerves, with accompanying vessels. The deep epigastric artery and vein run upwards under the retracted muscle to the inner side, and it is well to define these vessels, otherwise the vein may be punctured in the later suturing of the sheath. Another anatomical point of importance is the

level of the transversalis fascia as regards the wound, for it strengthens the posterior layer of the sheath and makes the hold of the sutures much firmer if the opening into the peritoneal cavity can be confined to the part covered by it. In most instances the incision can be made through the posterior sheath between the nerves and through the fascia. We have not, however, seen any ill effects from division of these nerves, although it has been suggested that partial atrophy or paralysis of the rectus muscle might ensue. If the case is uncomplicated by any adhesions and the appendix is lying in a normal position, the operation can be completed through an inch-long incision of the posterior sheath; but if there are complications and it is considered necessary to do so, the wound, both superficial and deep, can be extended to any required distance. After the appendix has been removed by the method which is considered best, and the peritoneum cleansed, the posterior layer of the sheath and peritoneum can be sutured in the usual manner. . . . The uninjured rectus is now permitted to fall back into its usual bed; the anterior layer of the sheath is closed by three or six interrupted (.00) silk sutures, and the skin and superficial wound by a continuous horsehair stitch. Union takes place throughout by first intention, and the horsehair stitch is removed on the eighth day.

2. ABSCESS IN CONNEXION WITH DISEASE OF THE APPENDIX.

It has already been pointed out that the position of the appendix varies greatly in different individuals, and also, probably, in the same individual at different times. In whatever position the appendix lies, an abscess may form in connexion with it. The position of an appendix abscess, therefore, is as varied as that of the normal appendix. An appendix abscess may occupy a part or the whole of the iliac fossa; it may push the cæcum upwards, or upwards and inwards. If the appendix lies behind the cæcum, occupying the retrocolic fossa, the abscess may be completely covered by the cæcum and ascending colon.

When the appendix lies to the outer side of the ascending colon, an abscess may be placed a little internal to the ante-

rior superior spine, or above the iliac crest, or it may occupy the loin, or extend upwards along the colon and have its larger part immediately beneath the liver, or, finally, the abscess may be beneath the diaphragm. If the appendix lies with its tip pointing upwards and inwards to the spleen, in front of the ileum and the mesentery, but behind the omentum, the abscess spreads towards the middle line, forming a tumour which occupies the inner part of the iliac fossa and which increases along its upper and inner boundaries. If the appendix hangs with its free end over the brim of the pelvis, the abscess may lie along the iliopectineal line or at the side of the pelvis; or when the appendix is of greater length, the abscess may occupy the space between the bladder and rectum in the male or between the bladder and uterus, or uterus and rectum, in the female.

An appendix abscess, it will be seen, may be placed in any position in which the appendix may lie. In rare instances, when the enteric mesentery is continued on to the ascending colon and the cæcum is freely movable, the appendix may be found at any part of the abdomen. In two cases I have operated for appendicular abscess on the left side of the abdomen and many such cases are recorded by others. In 44 cases Barnard noted that the position of the abscess was as follows:

External Abscesses.		Internal Abscesses.	
Lumbar	4 cases.	Iliac (behind the mesentery)	10 cases.
Subhepatic	4 "	In front of sacral promontory	2
Subphrenic	4 "	Pelvic	14 "
Retrocæcal	4 "	Above Poupart's ligament	2 "
Total	16 cases.	Total	28 cases.

When the abscess occupies the iliac fossa, there is rarely any difficulty in recognising or in defining its exact limits. This is done by gentle palpation; percussion gives no information that is not misleading. An abscess whose margins are clearly defined may be resonant on percussion, and may, when opened,

be found to contain at least a pint of pus. Conversely, dulness or diminished resonance may indicate nothing more than an overfull cæcum. There may perhaps be a difficulty in deciding whether the increased resistance felt in the right iliac fossa is indicative of a protective tightening of the muscles when a limited peritonitis is present, or whether there is a mass of inflammatory deposit in the centre of which an abscess lies. Gentle but firm and prolonged palpation with the hand laid flat upon the abdomen will almost always enable an accurate decision to be made. It will gradually be recognised that in the one case the resistance is only superficial, and that in the other there is a mass beneath the resisting muscles; that the hardening, in the one case, is in the form of a square, and in the other, in the form of a cube.

When the abscess lies to the outer side of the ascending colon, palpation over the iliac region may reveal no abnormal condition. When the definite symptoms of appendicitis are present, this may cause some perplexity. When, however, the loin is examined bimanually, as is done in the investigation of kidney tumours, it will be recognised at once that a considerable mass lies between the two hands. Very often, in such cases, the patient may give the surgeon a lead by complaining of pain in the loin or of pain spreading up the right side of the abdomen.

When the abscess lies deep in the pelvis it may be wholly unrecognisable upon abdominal examination. Upon rectal or vaginal examination or upon bimanual examination it is at once perceived. It may, at times, bulge into the rectum, and lie so thinly covered that on making a rectal examination the finger may open the abscess cavity, however gently the manipulation is conducted.

When the abscess lies along the intestines at a distance of an inch or more from the abdominal wall, it may not be possible to recognise it, however carefully the examination be made. Such a position, for this reason among others, renders the case more serious perhaps than any other.

Operation.—In treating an abscess in connexion with the appendix by operation two points are of great importance: *In the first place*, it is necessary to make the incision over the most projecting or superficial part of the abscess. The usual incision for the removal of the appendix is by no means always the proper incision for the opening of an abscess. The abscess, in fact, should be dealt with as an abscess elsewhere would be—that is to say, the incision must be made into the part of it most easily accessible. *In the second place*, it is essential to provide for free drainage from the lowest part of the cavity. It is found by experience that those abscesses which empty themselves spontaneously through the rectum or vagina heal more rapidly than similarly placed abscesses opened through the abdomen. The drainage from the lowest point hastens the closure of the cavity. This procedure should be imitated as closely as possible when the surgeon operates. Efficient drainage in the easiest direction must be secured, and in many cases two or more outlets for drainage must be provided.

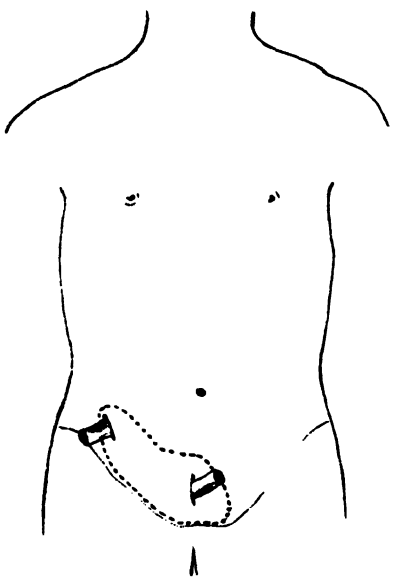


Fig. 212.—Appendix abscess, drained at each extremity.

The abscess, having been carefully examined and its limits clearly defined, an incision is made over its most projecting part. As the incision is deepened, it will often be noticed that there is œdema of the abdominal wall. This œdema is a sure indication of the presence of a high degree of inflammation and that pus is present in the parts beneath; and it is an evidence

that the incision is being made in the proper place. The incision is deepened by degrees, and with more than the ordinary care, for if a coil of bowel be adherent to the abdominal wall, there is a risk of wounding it. When the thickened peritoneum is incised, the abscess will be opened and pus will escape at once. If by any chance the general cavity of the peritoneum is opened, a packing of gauze is at once introduced to make a barrier around the abscess. The gauze should be in long strips about two inches in width, and with five or six layers if the gauze be thin. While the wound-edges are held apart the gauze is packed in a thick layer all around. Such a barrier affords the completest protection to the peritoneum;

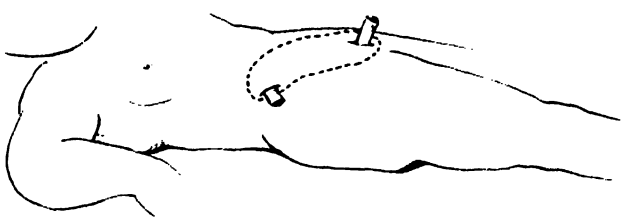


Fig. 213.—Appendix abscess drained above the pubes and through the loin.

even if much soiled upon the side towards the abscess, the outer side will remain clean. The abscess being opened, the finger is at once introduced and an examination, sufficient yet scrupulously careful, is made. When the finger is discovering the limits of the abscess, the greatest gentleness is necessary, for rough handling may break down the limiting adhesions, and pus may escape into the general peritoneal cavity and start an acute peritonitis. In the investigation of the cavity it is of great importance to determine that which is the lowest limit of the abscess with the patient in the recumbent position. For if the abscess be of large size, the opening which has been made into it may suffice for the drainage of the greater part of the cavity, but may yet leave undrained a pocket at the upper or

at the lower limit. If this is so, then one or two more incisions may be needed. These are made at such points as will secure the easiest drainage.

The question as to the need for the removal of the appendix has been hotly debated. My own practice is this: if the appendix comes into view at once, or after the simplest examination, I remove it; if, however, a prolonged search, during which adhesions have to be freely separated, be necessary, I do not make any attempt to remove it. In the search a small fæcal concretion may be discovered or an offending foreign body of different character; this, which has escaped from the perforation in the appendix, should always be carefully sought and removed. There can be no doubt, I think, that in many cases of abscess the removal of the appendix is unnecessary, and that in almost all its removal involves far too much risk to be desirable.

The recurrence of appendicitis after an abscess of the appendix has been opened and drained has been estimated to occur in 2 per cent. of cases. This is the number which is mentioned by Treves. Coley, as the result of the examination of a large number of cases, came to the conclusion that 20 per cent. was a more accurate estimate. The former estimate is certainly far too low; the latter is perhaps rather too high. The probability is that approximately 10 per cent. of patients suffer from attacks of appendicitis after the drainage of an appendix abscess. In this 10 per cent. a secondary operation will be needed in perhaps the majority, but it can be performed in the quiet interval after an attack, and the risk is accordingly very small.

If the appendix be found in the cavity of the abscess, it will be thickly covered with lymph, turgid and greatly thickened. It may then be removed by applying a single ligature to the mesentery and by applying a clip to the base of the appendix, tying a ligature in the groove left when the clip is taken off, and cutting through the appendix and its mesentery distal to the ligatures.

When the abscess cavity is thoroughly exposed, it may be washed out with hot sterile salt solution or may be sponged as clear as possible. In either case the finest care is necessary to prevent the breaking-down of adhesions. As a rule, I do not employ lavage unless the abscess is excessively foul.

The abscess having been emptied, cleansed, and the appendix removed if readily accessible, the drainage-tubes are introduced and the wound is closed. It is in the freedom of drainage that the success of the operation mainly depends. The drain must be of a large size, and as many separate tubes must be introduced into the cavity as will ensure that a free escape of pus is permitted. If the abscess extend upwards and backwards to the loin, a drainage-tube may with advantage be introduced through a separate incision through the side or through the iliocostal space. A split rubber tube with a loose gauze wick affords the best drainage. It is essential that the drain, whether of gauze or of india-rubber tubing, should not be hastily removed. A too early removal may lead to a closure of the skin-wound before the abscess cavity has granulated, and a fresh collection of pus may form, requiring a further operation. Rapidity of healing is not to be desired unless the wound is closing soundly throughout and unless the abscess cavity is slowly contracting.

The only differences in treatment which are necessary in other abscesses developing in connexion with a diseased appendix have reference to the position of the incision and to the insertion of drainage-tubes. If the abscess be in the pelvis, an incision through the linea semilunaris or through the middle line will give access to it. In cases such as these a bulging of the abscess into the rectum or vagina may be felt, and, if necessary, a second incision may be made into the abscess from these points. There is no doubt that when an abscess bursts spontaneously into the rectum or into the vagina it drains very freely and closes more rapidly than it would do if an incision had been made through the abdominal wall. I have on several

occasions drained a pelvic abscess in the female through the vagina, and on three occasions have drained an abscess through the rectum as well as through an abdominal opening. The healing in all has been very much more rapid than it would have been if only one incision had been made.

When the abscess lies at a little distance from the anterior abdominal wall, it must be opened through an incision made

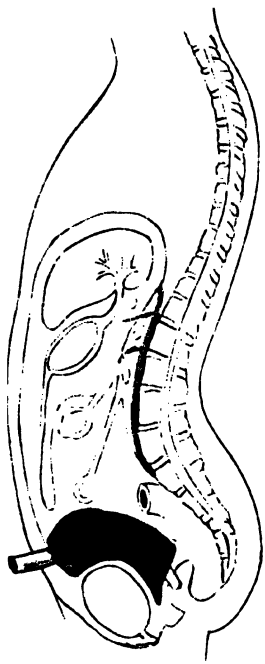


Fig. 214.—Appendix abscess; drained above pubes, and through the rectum (in the male).

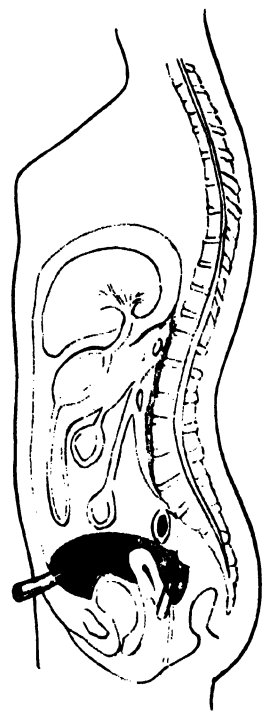


Fig. 215.—Appendix abscess; drainage above pubes, and through vagina.

over the point which is most accessible. After opening the abdomen and before setting free the pus the general cavity of the peritoneum must be carefully protected by substantial barriers of gauze packed snugly all around the margins of the incision. When this has been done, the finger is passed gently down to the abscess, disentangling adherent coils of bowel until pus is seen to flow. The discharge is rapidly mopped up and

the swabs at once thrown away. This is continued until the abscess is empty. A large drainage-tube is then passed to the centre of the abscess; the surrounding strings of gauze are left in position or changed, if much soiled. The drains are left for several days before being disturbed, in order to ensure that an impenetrable barrier of adhesions has been built up around the track.

3. APPENDICOSTOMY (WEIR'S OPERATION).

Within the last few years a happy and ingenious device for utilising the appendix as a means of ready access to the large intestine has been suggested. So far as I have been able to ascertain, the first mention of this surgical employment of the appendix is due to C. B. Keetley. In a debate at the Medical Society of London ("Brit. Med. Journal, vol. ii, 1894, Nov. 17, p. 1112) he recommended the opening of the appendix as a substitute for typhlotomy in the treatment of acute obstruction in the large intestine. The suggestion passed unheeded, and it is only since a paper by Dr. Weir, of New York ("Medical Record," 1902, August 9, p. 201), was written that the operation of "appendicostomy" has become a recognised procedure. The following is an abstract of Dr. Weir's description of his case:

A young man, aged thirty-one, had had for nearly three years persistent diarrhœa, associated lately with the passage of blood. An exploratory incision above the umbilicus shewed thickening and congestion of the colon. It was then determined to resort to a cæcal fistula, and the usual incision with intermuscular separation was made. "As the cæcum was exposed the appendix rose so suggestively into view that I determined to employ it to make the desired fistula." It was fastened to the skin and the wound closed. The tip of the appendix was opened and a No. 12 English catheter passed into the cæcum. The tip was then closed by a temporary ligature. Three days later, irrigation was resorted to with most satisfactory results.

The first operation in England was performed by myself on

August 5, 1903, in a case of mucomembranous colitis. The patient, a girl of twenty-one, made a good recovery. Saline injections were used daily for about three months; during this time the mucous discharge and the blood ceased entirely and the girl gained weight. The injections were then discontinued and the appendix opening scabbed over and closed. For eighteen months the improvement was maintained, but latterly there has been a recurrence of the sanguineous and mucous discharge and the patient is losing strength.

Indications for the Operation.—The appendix, when brought to the surface and opened, may be used as a means of entrance to, or of exit from, the large intestine; as the former, when it is necessary to flush out the colon or to administer fluids for any purpose; as the latter, when a means of escape, a vent, is needed in cases of obstruction in the large intestine.

The indications for the operation therefore are:

1. As a means permitting local treatment of certain conditions of the large intestine.
2. As a vent in cases of acute obstruction in the large intestine in place of typhlotomy.
3. It has been suggested that nourishment may be given, in certain cases of rectal intolerance, by this avenue.

1. As a means for the treatment of various conditions of the large intestine; of such are, according to Keetley:

(*a*) Mucomembranous colitis.

(*b*) Dysentery (that is, amœbic colitis).

(*c*) Obstinate chronic constipation.

(*d*) Ileocæcal intussusception; to prevent recurrence, to prevent collapse, and to treat hæmorrhage and inflammation.

(*e*) Syphilitic ulceration of the colon.

Mucomembranous colitis is a peculiarly intractable disorder. It is generally recognised that the administration by the rectum of various drugs expected to exert a local influence upon the mucous membrane of the colon has proved on the whole most

unsatisfactory. The opening of the appendix certainly ensures that the whole length of the colon can be treated, and that the lodging of fæcal material in a diseased colon can be prevented. It is for this purpose, chiefly, that the operation of appendicostomy will be useful.

So far as concerns chronic constipation I have no hesitation in saying that it is a condition for which any surgical treatment can only be very rarely necessary. The recent enthusiastic advocacy of ileosigmoidostomy in this connexion is based upon wholly inaccurate suppositions; and the results have not been such as to encourage a continuance of this practice. Constipation, apart from organic disease, is not a condition to be treated surgically. I do not think, therefore, that appendicostomy will prove of value in this connexion; although if it were conceivable that operative measures should be adopted, this method would certainly be the first to suggest.

Keetley mentions ("Brit. Med. Journal," vol. ii, 1905, p. 863) a case in which, after reducing an intussusception, he performed appendicostomy. He mentions cases recorded by Dawbarn, Meyer, Spencer, Hutchinson, myself, and Armour.

2. As a substitute for typhlotomy in cases of acute obstruction in the large intestine. This, I venture to think, will be the chief use to which the operation will be put in the future. In a case of carcinoma of, say, the hepatic flexure, in which a chronic obstruction has become acute, a short-circuiting operation may be done—ileosigmoidostomy; or the appendix may be brought to the surface and opened; or the two operations may be done at the same time, the former to allow of emptying of the small intestine, the latter to allow the escape of a large amount of thin fæcal material always found between the ileocæcal valve and the growth. I have three times performed the operation in such circumstances, and the drainage through the appendix (which readily permits of dilatation by a catheter) has been free and sufficient. As compared with typhlotomy the operation has enormous advantages. As every surgeon knows, the opening of

the cæcum or of the ileum, low down, is a cause of great distress to the patient by reason of the excoriation of the skin. In my cases of appendicostomy there has been no leakage for the first three or four days, and very little, not more than a few drams, daily after that. This leakage could be prevented by removal of the catheter for a few hours daily, or perhaps by its introduction

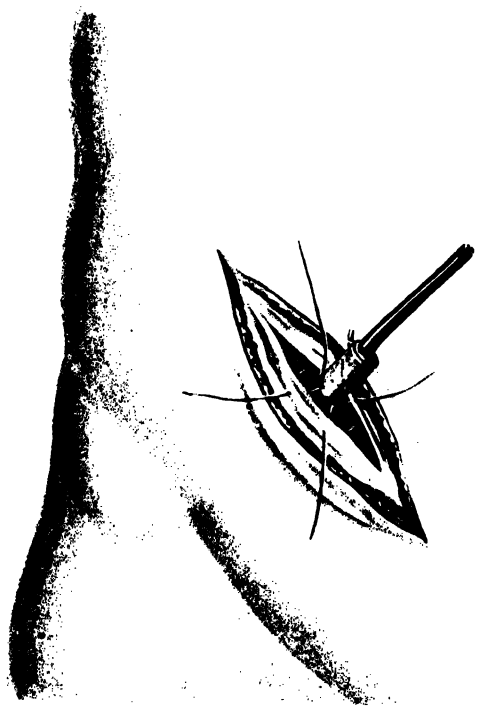


Fig. 216.—Appendicostomy. The incision in the skin is made long to shew the details of the operation. It need not be longer than 1 to 1½ inches when the operation is performed during life.

for an hour three or four times a day. When the catheter is out there is no leakage.

3. For purpose of administering nourishment. There are certain cases of gastric disease in which rectal feeding must be carried out, to the exclusion of feeding by the stomach. If in

such a case there be rectal intolerance the question of opening the appendix may be considered.

Operation.—The operation is carried out precisely in the same manner as is necessary when the appendix is to be removed. McBurney's incision is used, a very small opening—just large enough for two fingers—being made. The appendix is sought and brought to the surface. If adherent, the adhesions are separated; in themselves they are no bar to the operation. When the appendix is free it is brought out of the wound and dragged upon gently until its base is on a level with the parietal peritoneum. The mesoappendix is then secured to the peritoneum by a single catgut stitch and a similar stitch is then passed through the opposite portion of the appendix, securing it to the peritoneum. The muscles are then allowed to return to their natural position, and if need be, a stitch ensures good apposition of their fibres. The skin wound is closed, and each side of the appendix is attached to the skin by a silkworm-gut suture which picks up its serous and muscular coats. The opening of the appendix may be performed forthwith, or may be delayed for a couple of days. All that is necessary is then to snip off the end of the appendix and to thread into its lumen a silk or rubber catheter. It is at first a great surprise to one to find how much the appendix will dilate to permit of the passage of the catheter. A No. 12 catheter passes quite easily.

The catheter may be left in, in cases of acute obstruction, or may be passed and removed as often as is desirable in cases of mucous colitis. There is never leakage when the catheter is out. When it is desired to discontinue the use of the appendix, the abdomen may be reopened and the appendix removed. In my own patient the little opening scabbed over, and dried up completely in about a fortnight after the injections were stopped.

CHAPTER XXXI.

INTESTINAL PERFORATION IN TYPHOID FEVER.

This subject has been most ably and most exhaustively dealt with by Dr. Richard Harte and Dr. Ashhurst, of Philadelphia, in a paper published in the "Annals of Surgery" in January, 1904. Any surgeon interested in this subject will find in this paper all the information at present available. The examination of all recorded cases is given in detail, and there is abundant internal evidence that the paper is based upon an ample personal experience. The description which follows is borrowed largely from this very admirable article.

The frequency of perforation of the intestine in typhoid fever is variously estimated by different writers. The estimates vary between 1 per cent. and 11 per cent. Griesinger, in the following table, shews the number of cases in which perforation occurred and the percentage occurrence (Harte):

	Cases.	Perforation.	Percentage.
Liebermeister	2000	26	1.30
Murchison	1580	48	3.03
Griesinger	118	14	11.01
Flint	73	2	2.70
Curschmann	829	22	2.70
Montreal (Armstrong)	932	34	3.66
Episcopal Hospital (Harte)	1556	34	2.18
Pennsylvania Hospital	1793	49	2.50

The perforation is generally found to have occurred at the base of a small, deep, punched-out ulcer. It is in the great majority of cases found in the last twelve inches of the ileum. In 190 cases in Harte and Ashhurst's series of 362 cases it was found in 140 (73 per cent.) within twelve inches of the cæcum. In only 4 cases (2.1 per cent.) was it distant more than 3 feet from the cæcum. In 7 cases the colon was perforated; of these, 5 were perforations of the ascending colon, 1 of the

transverse, and 1 of the sigmoid flexure. There were 3 cases of perforation of Meckel's diverticulum and 8 of perforation of the appendix. The perforation is generally single, but there may be more than one; in a few recorded cases the perforations have been numerous.

Perforation, as a rule, occurs in the more severe cases of typhoid fever, but it may also occur in examples of the ambulatory form. It is in the third week that the danger of perforation is greatest. The chief points of diagnostic importance are the sudden increase of pain or the onset of pain which previously was absent, and the muscular rigidity. The abdominal wall is hard and rigid. The gentlest palpation shews that the muscles are tightened and on guard. The rigidity is seen earlier and to a more marked degree in the right side of the abdomen.

The **operative treatment** of perforation in typhoid fever was initiated by Professor von Mikulicz (who was also the first surgeon to operate for the perforation of an ulcer of the stomach and for hæmorrhage from a gastric ulcer). The first operation was performed on April 7, 1884, and was followed by recovery. As a rule, very little anæsthetic is needed for these patients. Their condition of prostration is such that but very little chloroform or ether is necessary to produce unconsciousness. Local anæsthesia has, in practice, been found unsatisfactory, though if the plight of the patient is desperate, the operation may be performed under cocaine and a whiff of chloroform may be given if pain is intolerable. The skin of the abdomen is cleansed as thoroughly, but as gently, as possible. Speed is a matter of the utmost importance. As Harte and Ashhurst say: "In too many instances it is a race with death, and there are often anxious moments when it is questionable who will win."

The abdomen is opened through either a median or a right lateral incision. My own preference is for the median incision, for no matter where the perforation may prove to be, a ready access to the lesion is attainable. Harte and Ashhurst, how-

ever, advise the lateral incision, through the outer half of the right rectus muscle, for "it is a route that gives direct access to our landmark, the cæcum, and to that part of the small gut most often affected; it affords quite sufficient room for exploring nearly the whole abdomen; it can be extended in either direction at need, and it offers excellent drainage facilities." If the incision first made does not permit of an adequate exposure of the bowel, a second must be made in a more convenient place. When the abdomen is opened, the portion of the ileum affected may present at once in the wound. If there is a larger quantity of lymph clinging to the bowel, it is probable that a very minute perforation will be found, and that some thick deposit of this lymph will seal it; if there is a large quantity of thin fluid fæcal exudate, the probability is that the opening in the bowel is a large one.

If the damaged gut does not at once present, the cæcum is sought, and the ileum traced upwards from it, the appendix being first examined. As a rule, the lesion is almost at once disclosed; but if it is not, the search must be rapidly continued, the lower three or four feet of the ileum being gently pulled towards the wound, and, if found intact, the ascending colon is explored. In all these manipulations the greatest gentleness is necessary, for other spots may be the seat of ulcers which are prone to perforation. The affected area may sometimes be quite limited, a patch of inflamed peritoneum with an abundant lymph deposit being seen on the right side of the pelvis when all other parts are unhurt. If this be so, a protective barrier of gauze is erected around it, so as to avoid any soiling of the general peritoneum.

As soon as the perforation is disclosed the loop of bowel is pulled out of the wound, packed round with gauze swabs wrung out of hot sterile salt solution, and sutures are applied. In cases of extreme distension of the bowel, the opening may be used as a vent, and through it much liquid fæces and gas may be emptied away, due care being taken to avoid any soiling of the operation area.

If the opening be small, a purse-string suture may be used to close it, and this may be buried by one or two points of a Lembert stitch. If the opening be larger, it must be sutured, in the usual manner, by a double layer of continuous stitches, the inner taking up all the coats of the bowel, the outer the seromuscular layers only. There is no need to excise the ulcer. The sutures are applied in the long axis of the gut, or, if it seems likely that the lumen will, in that way, be narrowed, they may be placed in the transverse axis. The opening being securely closed, the bowel is washed over with hot saline solution and returned to the abdomen. Other perforations are then sought.

The closure by suture in the simple manner described is not always possible, owing to the large size of the perforation, the existence of many perforations close together, or to the extremely prostrate condition of the patient. Alternative methods of treatment have then to be considered. These are the formation of a fæcal fistula, by bringing the opening up to the surface and stitching the bowel there, or by leaving the perforated loop at the bottom of the wound and packing round it; lateral anastomosis or resection with end-to-end anastomosis. Harte and Ashhurst write: "Of four cases treated by the establishment of a fæcal fistula, every one died. This tremendous mortality, however, does not prove that the operation is necessarily fatal in cases of typhoid perforation, but merely that it has been employed only in exceedingly ill patients. On the other hand, of those sixteen patients who withstood the immediate shock of the operation and in whom a fæcal fistula developed in the wound after operation, only two died the surprisingly low mortality of 12.5 per cent." Intestinal resection in their series of cases was employed five times, with only one recovery.

When the openings have been dealt with, in what seems the most appropriate manner, the abdominal cavity is cleansed. The most satisfactory manner of accomplishing this end is by the washing out with hot saline solution. A soft-rubber tube

attached to a funnel is used, and, as the fluid is poured in, the tube is gently moved among the coils of bowel until the fluid, wherever directed, returns clear. The temperature of the fluid should be 105° to 110° F.

With regard to the bacterial conditions present in the various forms of perforation, Harte and Ashhurst write:

"With regard to the bacteriology, it has been found that in cases where the typhoid bacillus alone is the infecting cause, the usual lesions are a low-grade peritonitis, frequently lemon-coloured exudation, few adhesions, and not much lymph. Where the streptococci or the staphylococci abound, the lymph is more abundant, and adhesions are the rule if the peritonitis has lasted more than a few hours. The prognosis is much more grave in the streptococcic infection than in the typhoid. An interesting case in this connexion was observed at the Johns Hopkins Hospital. At the first operation in a patient suffering from typhoid perforation bacteriological examination of the peritoneum shewed no organisms, while the intestinal contents contained streptococci in abundance; this patient was later subjected to a second laparotomy, at which time the peritoneum was found to be infected by the streptococci, and death soon followed from the peritonitis. Evidently in this case the time which elapsed between the initial symptoms of perforation and the operation—five and a half hours—was not sufficient to infect the peritoneum extensively with intestinal contents; whereas forty-three hours later, when the second operation was performed, general purulent peritonitis was well advanced."

When the peritoneal cavity is clean, the abdominal wound is sutured in the usual manner. Drainage is always adopted. For almost all cases I prefer the split-rubber tube with a gauze wick. Two of these may be placed side by side in the central incision, the wick from the one lying on the right side of the pelvis and being directed to the sutured wound in the bowel, that from the other trailing along the left side. If the iliac fossæ are deeply soiled, they may be drained through separate lateral incisions, though this is rarely necessary.

The gauze wicks may be removed after the third day. Removal before this is painful, difficult, and unnecessary. If, at the first trial, the gauze does not readily come away, it may be left another twenty-four or forty-eight hours before the attempt to withdraw is renewed. The patient is propped up with two or three pillows in bed.

So far as the after-treatment is concerned, nothing more judicious has been written than the advice given by Harte and Ashhurst. They say:

"After twenty-four hours a teaspoonful of hot water may be given by the mouth every ten or fifteen minutes. Thus taken it is less apt to nauseate, and is probably all absorbed before reaching the stomach. No food should be given by the mouth until the third or fourth day at least, nutritive enemata being meanwhile continued. One or two cleansing enemata of plain water in the twenty-four hours are usually sufficient to remove all fæcal matter. When mouth-feeding is begun, it should be borne in mind that the patient has both typhoid fever and a sutured area in his intestine, and he should be fed accordingly. Those cases do best where, the acme of the disease being past, a fairly liberal diet can be allowed early. Those patients, on the other hand, who, although they were in fairly good condition at the time of perforation and so have borne the operation well, but have yet several weeks of fever with which to contend, are very apt to die during the second or third week after the operation."

The following tables are copied from Harte and Ashhurst:

ANALYSIS OF WHOLE NUMBER OF CASES.

Recovered	94
Died	268
Total	362

Mortality, 74.03 per cent.

ANALYSIS OF CASES WHERE AGE AND SEX ARE KNOWN.

Age.	Male.			Female.			Total.			Mortality Per Cent.		
	Recovered.	Died.	Total.	Recovered.	Died.	Total.	Recovered.	Died.	Total.	Male.	Female.	Total.
Under 10 years...	3	2	5	1	3	4	4	5	9	40.0	75.0	55.5
10–15 " ...	9	10	19	3	3	6	12	13	25	52.6	50.0	52.0
15–20 " ...	6	29	35	1	2	3	7	31	38	83.0	66.6	81.8
20–30 " ...	16	70	86	8	19	27	24	89	113	81.4	70.3	78.0
30–40 " ...	13	44	57	6	6	12	19	50	69	77.2	50.0	72.4
40–50 " ...	8	10	18	1	2	3	9	12	21	55.5	66.6	57.1
50–60 " ...	0	3	3	0	1	1	0	4	4	100.0	100.0	100.0
Total	55	168	223	20	36	56	75	204	279	75.3	64.2	73.1

ANALYSIS ACCORDING TO DURATION OF PERFORATION BEFORE OPERATION.

Cases Operated on.	Recovered.	Died.	Total.	Mortality.
First 12 hours after perforation....	35	95	130	73.0 per cent.
Second " "	22	62	84	73.8 " "
Third " "	2	29	31	93.5 " "
Over 36 hours after perforation.....	18	37	55	67.2 " "

ANALYSIS AS TO THE PERFORATION.

Number of Perforation.	Recovered.	Died.	Total.	Mortality.
Single.....	65	171	236	72.4 per cent.
Multiple.....	5	30	35	85.7 " "
Size of Perforation.				
Under ½ (⅛) inch.....	35	37	72	51.3 per cent.
Under ½ inch.....	17	56	73	76.7 " "
Over ½ "	7	16	23	69.5 " "
Site of Perforation.				
Within 12 inches of cæcum.....	32	108	140	77.1 per cent.
" 24 " " "	7	32	39	82.0 " "
" 36 " " "	1	6	7	85.7 " "
Over 3 feet from cæcum.....	1	3	4	75.0 " "

ANALYSIS AS TO SITE OF INCISION.

Site.	Recovered.	Died.	Total.	Mortality.
Median hypogastric.....	21	75	96	78.12 per cent.
Right iliac.....	44	97	141	69.5 " "
Left iliac, abscess pointing.....	2	0	2	
Median epigastric.....	1	3	4	75.0 " "
Right hypochondriac.....	0	1	1	100.0 " "
Multiple incisions.....	3	11	14	78.5 " "
Drainage through loin, flank, or vagina.....	1	4	5	80.0 " "

ANALYSIS OF CAUSE OF DEATH IN EIGHTY-NINE CASES IN WHICH IT IS GIVEN.

Causes of Death after Operation.	Under Twelve Hours.	Under Twenty-four Hours.	Under Three Days.	Under One Week.	Under Two Weeks.	Over Two Weeks.	Total.	Per Cent. of Whole Number.
Pre-existent peritonitis	17	6	16	4	1	0	44	49.4
Toxæmia of typhoid fever	2	0	5	2	0	0	9	10.1
Peritonitis from subsequent perforation	0	0	3	2	3	2	10	11.2
Exhaustion	0	0	0	1	3	1	5	5.6
Intestinal hæmorrhage	0	0	1	2	0	0	3	3.4
Intestinal obstruction	0	0	3	0	0	0	3	3.4
Other causes, uninfluenced by operation.	7	0	8	0	0	0	15	16.8

Dr. W. D. Haggard, in a paper containing a review of many recorded cases, writes:

"The facts about intestinal perforation, which I have deduced from a statistical study of the cases, may be summarised as follows:

"1. It occurs more often in men than in women—80.9 *vs.* 19.1 per cent. It is, like hæmorrhage, rare in children.

"2. It occurs in about 2.5 per cent. of all cases of typhoid fever.

"3. 3.31 per cent. occur in the first week; 20.19 per cent. in second week; 38.94 per cent. in third week; 14.90 per cent. in fourth week; 9.13 per cent. in fifth week; 5.75 per cent. in sixth week; 7.21 per cent. from seventh to eleventh week, and has been observed as late as the one hundredth day (Curschmann). Holmes operated on one case after four months.

"4. It naturally occurs more frequently in severe attacks, but may occur in mild attacks, and it may be the first real symptom of so-called walking typhoid.

"5. It occurs in the ileum in 95.5 per cent., usually in 18 inches of cæcum (Osler), always in 3 feet (Loison); in the large intestine in 12.9 per cent.; and is most often situated in the ascending, transverse, and descending colon, sigmoid, and rectum, in the order named. It may occur, also, in the appendix, Meckel's diverticulum, and jejunum.

"6. The perforation is single in 84 per cent. There may be two or more, and in one case there were twenty-five (post-mortem). Cases with diarrhœa and tympany are more likely to have perforation. Six out of thirty cases occurred with hæmorrhage (Osler).

"7. The death-rate given by Murchison is 90 per cent. to 95 per cent. Osler says he could not recall a single case in his experience that had recovered after perforation had occurred."

CHAPTER XXXII.

INTESTINAL EXCLUSION.

By the term "exclusion of the intestine" is meant the rendering inactive any part of the intestinal canal by surgical means. When entero-anastomosis is performed, the length of intestine which lies between the two openings is "excluded." When the intestine is cut across, the distal end closed, and the proximal end united to the side of the distal, the part of the gut which lies between the two points dealt with is "excluded." When, finally, the intestine is divided at two points and the proximal end of the upper and distal end of the lower are united, the intervening portion is "excluded."

In the operation of entero-anastomosis as suggested by Maissoneuve, the exclusion is certainly not always complete. Le Dentu ("Rev. de Gyn. et de Chir. Abdom.," Paris, 1899, vol. iii, p. 81), in two cases of intestinal fistula, united the gut above to the gut below the opening, in the hope that the current of intestinal matters might be caused to deviate, and that thereby the fistula might close spontaneously. The fistula, however, continued to discharge in each case. Similarly, in a case of ileosigmoidostomy performed for obstruction due to a growth in the hepatic flexure, I made a small opening in the cæcum to give vent to a large collection of fæces and flatus. The growth in the colon was subsequently excised, but for several weeks there was some escape of fæces through the typhlotomy opening.

The following forms of intestinal exclusion are recognised:

1. Partial exclusion.
   (*a*) Entero-anastomosis of Maissoneuve.
   (*b*) Entero-anastomosis, with constriction of the part distal to the upper opening, by suture.

2. Complete exclusion.
   (*a*) Bilateral exclusion. When the bowel is divided at two places and the intestinal channel restored, leaving a segment of the bowel detached. Of this segment one end may be left open and the other closed, or both ends may be left open and stitched to the skin, or both ends may be closed when a fistula exists in the bowel lying between them, or both ends may be united to a segment of intestine into which the loop between them will drain.
   (*b*) Unilateral exclusion. When the gut is divided completely across and the proximal end implanted into the side of the distal. The distal end may be closed or may be left open.

In all operations of this kind it is desirable to open the abdomen, if possible in the middle line. The incision should be made at a distance from any fistula or any skin involvement. In such circumstances it may be impossible to obtain a clear view, owing to complex adhesions, or even to open the peritoneal cavity without wounding or perhaps opening some adherent coil of the bowel.

When the peritoneum has been opened, the intestine leading to and coming from the involved segment is defined. This is not always an easy matter, especially when many adhesions are present. It is desirable to work from some fixed point—the cæcum, by choice, or the duodenojejunal flexure. The rules already given for the recognition of any part of the intestine will be found of service.

When the proximal and distal portions of the bowel have been recognised, the former is divided completely across. The method of dividing it depends upon the purpose of the operator. If an end-to-end or end-to-side anastomosis is to be performed, it is divided between two clamps whose blades are sheathed with rubber tubing. If the ends are to be closed and a lateral approximation made (which is the method of choice when the



Fig. 217.—Intestinal exclusion, entero-anastomosis.

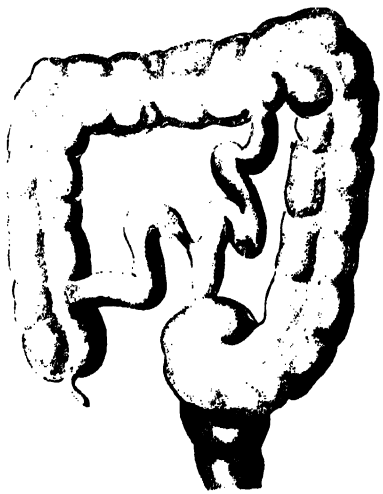


Fig. 218.—Entero-anastomosis with constriction by suture of the part distal to the upper opening.



Fig. 219.—Unilateral exclusion.

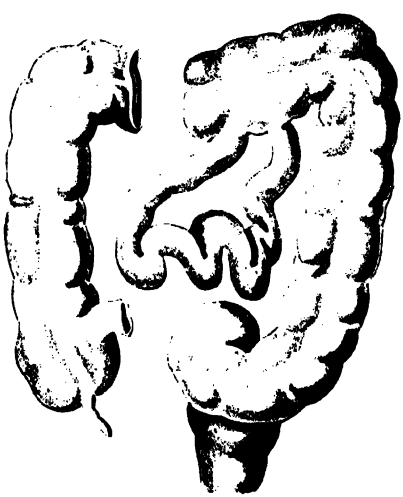


Fig. 220.—Bilateral exclusion, the distal end of the excluded gut left open.

small intestine has to be united to the large), then the bowel is crushed by forceps which divide all the coats except the peritoneum; two catgut ligatures are applied in the groove left when the forceps are removed, and the bowel divided between the ligature. The stump on each side is then buried by a continuous suture.

In unilateral exclusion an end-to-side anastomosis is performed. As a rule, the distal end at the point of division of the bowel may be closed, but in certain circumstances it may

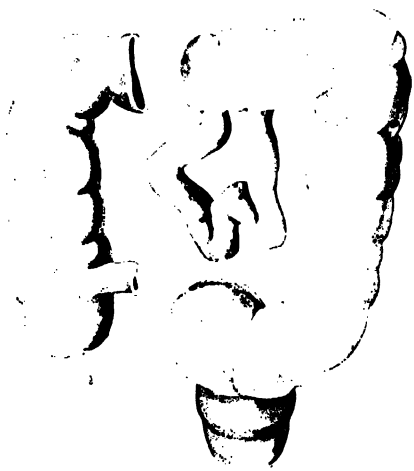


Fig. 221.—Bilateral exclusion. Both ends of excluded gut closed—fistula.

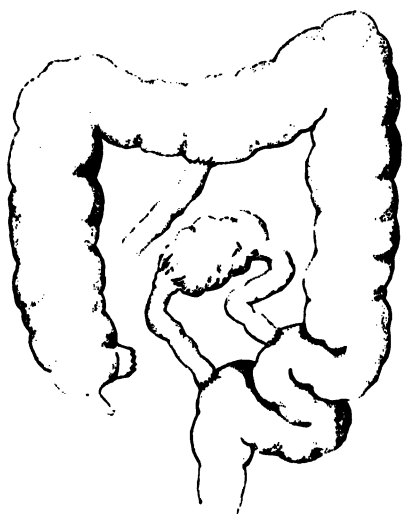


Fig. 222.—Bilateral exclusion, both ends of excluded segment joined to the sigmoid flexure.

be left open, either for purposes of drainage or to afford an opportunity for the irrigation of a septic area.

In bilateral exclusion one end at least of the sequestrated segment must be left open. As a rule, this should be the distal opening, so that peristalsis may help in its emptying. If both ends are to be left open, they may be brought out side by side through the same incision, not necessarily the original incision,—or a separate opening may be made for each. In rare cases the loop thus cut off may be short and may have a free opening with the surface; both ends may, therefore, be

closed. This, however, is neither prudent nor desirable. Vautrin has urged that when the excluded portion of the gut is infected, or sloughing and foul from cancerous ulceration, the two ends should not be laid side by side, so that the channel from one to the other is circuitous, but that two openings should be made—one for each end of the gut, which should lie untwisted and free from kink between them. Free irrigation of the coil is then possible.

When bilateral exclusion has been performed, some operators have closed both the ends of the sequestrated coil. This practice had, indeed, been advocated by Obalinski, but in a later publication he decides that it is inadvisable in the case of the small intestine, though permissible when the large intestine alone is involved. The practice has led to disaster. In many cases (Eiselsberg, Delagèniére, Roux) the excluded intestine has had to be opened, as symptoms of urgency were arising from the distension of the bowel. There can be no hesitation in condemning unequivocally any adoption of this method. It is unsound in theory and disastrous in practice.

In cases of unilateral exclusion the question has arisen as to whether the bowel between the point of division and the point of the lateral anastomosis undergoes any change. Experimentally it was found by Senn and others that it tended to undergo atrophy; the bowel withered, its lumen lessened, and its vessels became thin and shrunken. In the majority of recorded cases, however, it has been found that the intestinal contents have tended to pass backwards, and fistulæ in the excluded coil have continued to discharge. According to Delore and Patel and Hartmann, the only occasions upon which the excluded bowel remains absolutely empty are those in which the ileum has been divided near its termination and the proximal end implanted into the colon. The ileum between the point of section and the ileocæcal valve then remains permanently empty, for regurgitation is stopped at the valve.

There is, without doubt, some difference in this regard between unilateral exclusion performed upon the large and upon the small intestine. When performed upon the small intestine it is known, both by experimental evidence and as the result of operations upon man, that the excluded loop is constantly filled with fæcal material. If the proximal end of the excluded loop remains open to the surface, the discharge from it rarely ceases for more than a few hours. A fistula therein does not close. Unilateral exclusion of the small intestine does not offer, therefore, any advantages, either immediate or remote, over the entero-anastomosis of Maissoneuve. In the large intestine the conditions are slightly different. When the ileum is divided near its termination and the proximal end implanted into the ascending colon, there is some backward flow, as from the ileocæcal valve. The lower end of the ileum remains empty. If the proximal end be implanted into the sigmoid, there is little or no flow backwards along the descending and transverse colon during the early period. At a later stage of the case there may, however, be some passage of fæcal material backwards towards the cæcum. Druebert, in his experimental work upon dogs, found that during the first few weeks after the operation the motions were frequent and fluid in character. As time passed they became less frequent and more solid, and eventually the bowel movements were natural both in frequency and in character. If the intestine was examined during the early stage, the colon was always found empty and flaccid; during the later stage the colon had come to act as a reservoir from which a surplus quantity was from time to time discharged. These observations are confirmed by the experiences in man. In a case of unilateral exclusion, the ileum being joined to the sigmoid, Jaboulay found that at first the motions were frequently discharged and were always fluid; after a time they became semisolid, and at last normal. Körte has recorded a case of tuberculous disease of the cæcum treated by excision, followed by the implantation of the ileum into the sigmoid.

After the anastomosis had been completed the colon was narrowed by sutures in order to prevent regurgitation towards a fistula in the ascending colon. For six and a half months there was no discharge from the fistula; at the end of that time, however, fæces again passed through it. Körte then cut across the colon at the splenic flexure and closed both ends. The fistula ceased to discharge.

The conclusion to be drawn from the evidence furnished both by experimental work and by experience of cases in man is that unilateral exclusion of the small intestine offers no advantages over entero-anastomosis, and in the large intestine does not prevent, at any rate for more than a short period, the backward flow of fæcal matter.

The operation of bilateral exclusion has long been known as a laboratory method of cutting off from the intestinal current a segment of intestine for the purpose of studying the nature of the intestinal juice. A certain length of intestine is cut out, the intestine above and below it united, and both ends of the loop completely closed. A fistula is then made to the middle of the loop. This method of investigation was first suggested by Thiry in 1864. It was modified by Vella, who, instead of closing the ends, left them both open and brought them to the surface. The fistula is generally known as the "Thiry-Vella fistula."

Lance has collected the notes of 76 cases of bilateral exclusion performed in man. In 8 cases it has been practised upon healthy intestine for the purpose of causing to close a fæcal fistula resulting from operation or from strangulated hernia. All the cases recovered; in three a subsequent removal of the fistulous loop was successfully performed.

In the remaining 68 cases the exclusion was practised for various lesions, such as chronic invagination, chronic colitis, tuberculosis of the large intestine, cancer, pyostereoval fistula, and vaginal fistula. In no cases was there any ill effect attributable solely to the method. As a rule, when a fistula from the

excluded loop was not already present, the two ends of the intestine were brought to the skin. Sutured there this procedure is sometimes known as "Hochenegg's method" of exclusion. The pre-existing fistulæ closed rapidly in all the cases except those in which malignant disease was present. As a rule, only one end of the loop remained permanently open, the other gradually dwindling in size and eventually becoming quite closed.

Exclusion of the intestine was first performed on man by Trendelenburg on December 2, 1885. It is, however, to von Hacker that we owe the first deliberate suggestion, put forward in 1888, that complete exclusion of the intestine might be a successful means of treating certain lesions of the bowel complicated with adhesions and fistulæ. The suggestion did not attract general attention; it had, indeed, passed almost without recognition until Salzer, in 1891 and in 1892, gave it prominent advocacy. In reviewing a series of clinical records, Salzer endeavored to shew that in cases of diffuse phlegmon in the right iliac fossa complicated by adhesions and fistulæ the operation of enterectomy, always serious and not seldom fatal, might be avoided by an operation which detached the involved segment from the intestinal current. The bowel, relieved of the constant irritation aroused by the passage of fæces, would then tend to heal and the patient be thereby restored to health. A series of experiments performed upon animals demonstrated the possibility of the successful performance of the operation. Salzer himself, however, did not perform the operation in man.

Terrier and Gosset consider that exclusion of the intestine is indicated in all cases where there is a mechanical obstruction to the onward passage of the intestinal contents. The opinion, however, is not borne out by practical experience, for it is well known that in certain instances a lateral anastomosis is attended by most satisfactory results.

Exclusion of the intestine has been practised for the following conditions:

Tuberculous or simple ulcers of the intestine, which have

led to the formation of external fistulæ; the purpose of the operation being the diverting the fæcal current, and giving rest to the diseased portion of the bowel.

In intestinovaginal fistula following hysterectomy a bilateral exclusion is performed and the sequestrated loop drains into the vagina. The discharge soon lessens, and within a few weeks becomes almost imperceptible.

In chronic invagination the operation has been performed on three occasions.

In cases of artificial anus and fæcal fistula: In these conditions other operations are always to be preferred.

In cases of colitis an entero-anastomosis or a unilateral exclusion, the ileum being joined to the sigmoid, has been performed, with marked relief to the inflamed and perhaps ulcerated bowel.

In chronic intractable constipation, unilateral exclusion has been performed; the ileum has been divided about one foot above the ileocæcal valve and the proximal end implanted into the sigmoid or the upper end of the rectum.

The operation of exclusion of the intestine is chiefly necessary in cases of chronic inflammatory disease, probably tuberculous, involving the bowel and leading to external fistulæ; in cases of inoperable carcinoma of any part of the large intestine, especially of the cæcum and ascending colon; and in rebellious cases of mucomembranous colitis. From what has been said it will be recognised that unilateral exclusion, save in cases of disease affecting the lower end of the ileum, offers no advantages over lateral anastomosis; and that bilateral exclusion affords the best means of dealing with certain diseases, chiefly tuberculous and malignant, in the cæcum and colon, and with fistulæ between the small intestine and the bladder or vagina.

Lance, "Thèse de Paris," 1903, No. 348 (contains a list of all recorded cases).
Terrier and Gosset, "Revue de Chirurgie," 1901, vol. xxii, p. 29.
Delore and Patel, *ibid.*, 1902, pp. 669 and 797.
Hartmann, "Gazette des Hôpitaux," October 3, 1903, p. 1125.

SECTION IV.

OPERATIONS UPON THE LIVER.

CHAPTER XXXIII.

OPERATIONS UPON THE LIVER.

Access to the liver for surgical purposes may be obtained in the following directions:

1. Through an anterior incision opening the peritoneal cavity, as in exposure of the gall-bladder.

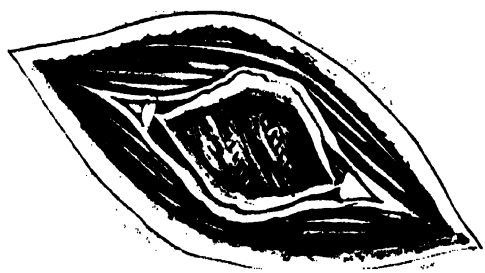


Fig. 223.—Exposure of liver by resection of a portion of rib and suture of the diaphragm to the liver (after Bickham).

2. Through an *anterior* incision along the seventh or eighth ribs, which are resected. The pleural cavity is traversed and the diaphragm incised.

3. Through a *posterior* incision along the eighth or ninth ribs, which are resected. The pleural cavity is traversed and the diaphragm incised.

4. Through a similar posterior incision. The pleural cavity is not traversed, but is avoided, the pleura being lifted upwards out of the way.

1. The first incision mentioned is that which is used for the exposure of the gall-bladder for the purpose of performing operations upon it or upon the ducts. A full description of Mayo Robson's, Kocher's, and Bevan's incisions is given elsewhere. Resection of the costal margin, as shewn in the annexed figures, gives a free exposure to the upper surface.

2, 3. The **transpleural** methods are performed in the same manner, wherever the incision may lie. In some instances the anterior incision, in others the posterior, may be necessary.

The posterior method is thus performed: An incision about

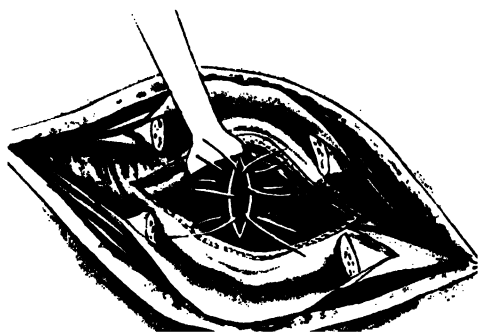


Fig. 224.—Exposure of upper surface of the liver after resection of portions of two ribs (after Bickham).

four inches in length is made along the line of the space between the eighth and ninth ribs; the middle of the incision corresponds approximately to the posterior axillary line, but is made a little further forward or further back if the exploratory puncture previously made should indicate that this is necessary. The latissimus dorsi and the external oblique muscles are divided freely and the ribs are exposed. Along the centre of the outer border of each rib an incision is made through the periosteum, which is stripped upwards and downwards until the outer surface of the bone is bared. The periosteum is then carefully stripped from the inner surface of the ribs with a curved ras-

patory, the greatest care being taken not to wound the pleura. As soon as the periosteum has been stripped at one point the raspatory is pushed sideways and the stripping of all the periosteum is thus rapidly effected. The bared portions, at least 2½ to 3 inches in length, are then excised. The parietal pleura is now exposed. It is sutured, before being opened, to the pleura of the diaphragm by a series of deep stitches taken with a large curved intestinal needle. The stitches are passed through



Fig. 225.—Osteoplastic resection. Resection of costal margin to expose the upper surface of the liver: the line of incision.

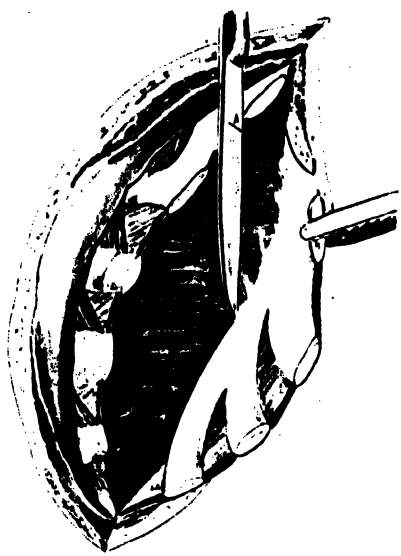


Fig. 226.—The costal cartilages dissected up. They are subsequently replaced.

the intercostal muscles, as well as through the pleura above and below, and, at each end of the divided ribs, through the periosteum. The stitches are deeply passed, are close to one another, and are drawn fairly tight. A continuous suture or interrupted sutures may be passed. There is little to choose between them. In the centre of this circle of sutures an incision is made into the pleura, or an ellipse of the pleura is excised. The upper surface of the diaphragm is now seen, and

is at once incised, and the liver is exposed. As a rule, the liver, in those cases where an abscess or an hydatid is present, will be found adherent to the under surface of the diaphragm, the parietal and visceral peritoneum being adherent. If this adhesion is not found, then a few sutures must be passed uniting the two. The liver is then incised.

In certain cases delay may properly be practised between the suturing together of the costal and diaphragmatic pleuræ

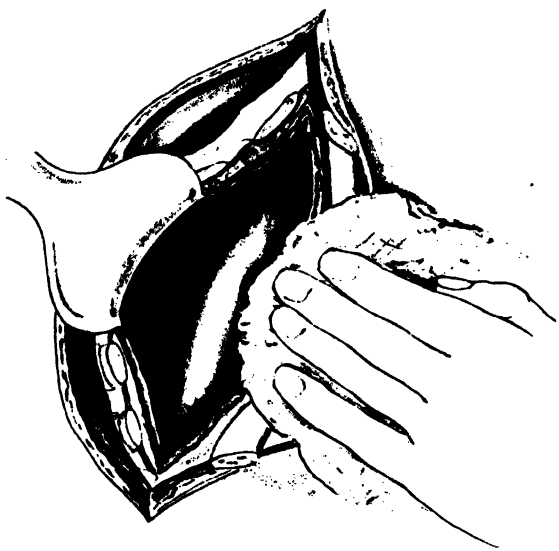


Fig. 227.—The cut margin of the ribs elevated by a retractor. The liver depressed by a hand protected by gauze (after Guibé).

and the incision through them into the abdomen. The wound is then packed with gauze; on its removal firm adhesions will have formed between the two serous surfaces so approximated, and any risk of infection of the pleural cavity is abolished.

4. The **subpleural method** is theoretically the most desirable, as avoiding any chance infection of the pleura. In practice, however, there is little to choose between the two.

The operation is carried out in the same manner as in the transpleural operation until the ribs are excised. The costal

pleura, which is then exposed, is stripped away from the under surface of the ribs by the pressure of the fingers covered with a strip of gauze. When the pressure is evenly and firmly made, the pleura strips away quite readily. When its lower margin is reached, the stripping is continued on the diaphragmatic pleura until a sufficient exposure of the bared diaphragm has been made. The lower thin reflection of the pleura is thus freed from all its attachments and is pushed upwards, and if the operation is to proceed at once, it is held away by a retractor and a pad of gauze. The incision of the diaphragm, which is the next step in the operation, is either carried out at once or is postponed for forty-eight hours, during which the wound is packed. Delay is, however, never necessary. The subsequent steps of the operation are those already described. A combination of the abdominal and of the transpleural incisions has been practised in certain cases. Edler, in one case of a wound of the liver in the tenth intercostal space, enlarged the wound of entrance upwards and downwards, resected the eleventh rib, exposed the diaphragm, in which a wound was found, and finally continued his incision downwards still further for the purpose of incising the peritoneum. Terrier also made both a transpleural opening and an abdominal opening, and connected the two, resecting two costal cartilages and incising the diaphragm in order to gain access to a wound of the liver.

The upper surface of the liver, when wounded, may be exposed either by the transpleural method or after opening the abdomen. The liver can be dragged downwards by an assistant, or, as Hahn has suggested, the suspensory ligament of the liver may be divided and the mobility of the organ be thereby greatly increased.

CHAPTER XXXIV.

INJURIES OF THE LIVER.

INJURIES of the liver may be due to blows, crushes, or falls, or to gunshot or to stab wounds.

Subcutaneous wounds are of three kinds (Kehr):

1. Rupture of the hepatic tissue, combined with tears in the capsule.

2. Separation of the capsule with subcapsular hæmatoma.

3. Central ruptures, which often give rise to separate or united hæmatomata, which may develop into cysts or abscesses.

Open wounds may be of any conceivable complexity, character, or extent.

The rupture may be small, and the division of the liver substance sharp and clean, or there may be great crushing of the liver substance, or a part of the liver may be detached completely from the rest and be found lying free in the peritoneal cavity.

Wounds of the liver may be single or multiple. It is important in all cases to determine the exact number and the precise extent of the wounds. The right lobe is injured six times as frequently as the left. The two serious features in all wounds of the liver are hæmorrhage and infection—the former is the more grave. Edler, in his statistics ("Archiv f. klin. Chir.," Bd. xxxiv, 1887), has shewn that hæmorrhage, if it proves fatal, does so within twenty-four hours. The need for operation, therefore, in suspected cases of wound in the liver is instant.

Gunshot and stab wounds of the liver may involve other organs also. The order of frequency in which the other parts are injured is given by Edler as follows: the diaphragm, the

ribs, the lungs and pleuræ, the stomach, the intestine, the kidneys, the spleen, the spine, the heart, the pancreas. The dangers of these wounds also are the more immediate one of hæmorrhage, the more remote one of sepsis.

TREATMENT.

In open wounds of the liver there can be no question as to the immediate necessity for operation, for the damage done to the parts is necessarily of such a character as to demand inspection; other viscera also may be injured, foreign bodies may be within the wound, bleeding may still be going on, or the contamination may be such that free opening and adequate cleansing must be performed at once.

In cases of subcutaneous injury the need for operation is by no means so imperative. There can be no doubt whatever that recovery from subcutaneous ruptures occurs by no means infrequently when no operation is performed. When the abdomen is explored for a possible rupture of the intestine a slight tear in the liver, which had not been suspected, is sometimes discovered. If the evidences of a rupture of the liver, such as the signs of shock and hæmorrhage, with the presence of fluid in the abdomen, or dulness in the right iliac fossa, the continuous increase in pain, due to progressive abdominal distension, and muscular rigidity, are absent, no operative intervention can be considered. Nevertheless, in such cases as these there may, afterwards, be undoubted proof, afforded by the symptoms, jaundice, hepatitis, and so forth, or by the inspection permitted in an operation for a different condition, that a slight laceration of the liver has been present.

OPERATION.

The liver, being exposed by some of the routes already described, the indications to fulfil are: the arrest of hæmorrhage and the closure, so far as is possible, of the wound in the liver.

Hæmorrhage may be arrested by suture, by ligation of the larger vessels, by forcipressure, by packing with gauze, by the actual cautery, or by the application of steam.

Suture of the Liver.—The stitching up of wounds in the liver was formerly thought to be impossible, owing to the great friability of the hepatic tissue. Experimental work by many observers and the treatment of cases of injury in man have shewn, however, that this belief was unfounded. The very ad-

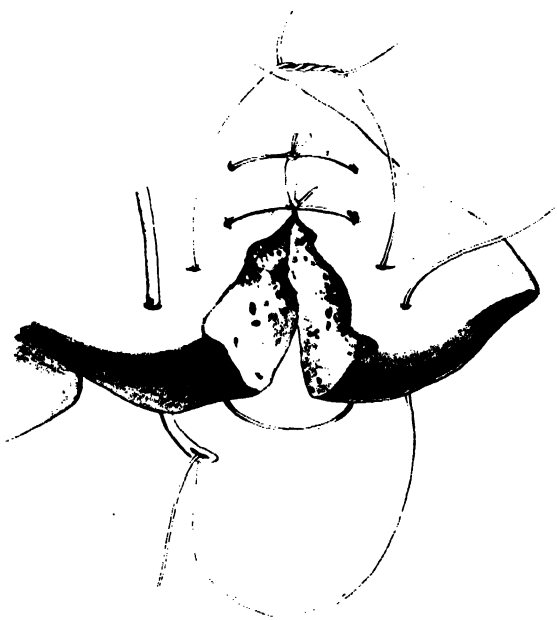


Fig. 228.—Suture of a wound in the liver (Kousnetzoff's needle).

mirable work of Kousnetzoff and Pensky ("Revue de Chirurgie," 1896, pp. 501 and 954) has placed our knowledge of the subject of suture of the liver on a surer basis. They have shewn that wounds in the liver may be stitched up with perfect ease and safety if a proper method be adopted, and that bleeding from the branches of the portal vein may be prevented by the ligation of each vessel. When the surface of the liver is cut,

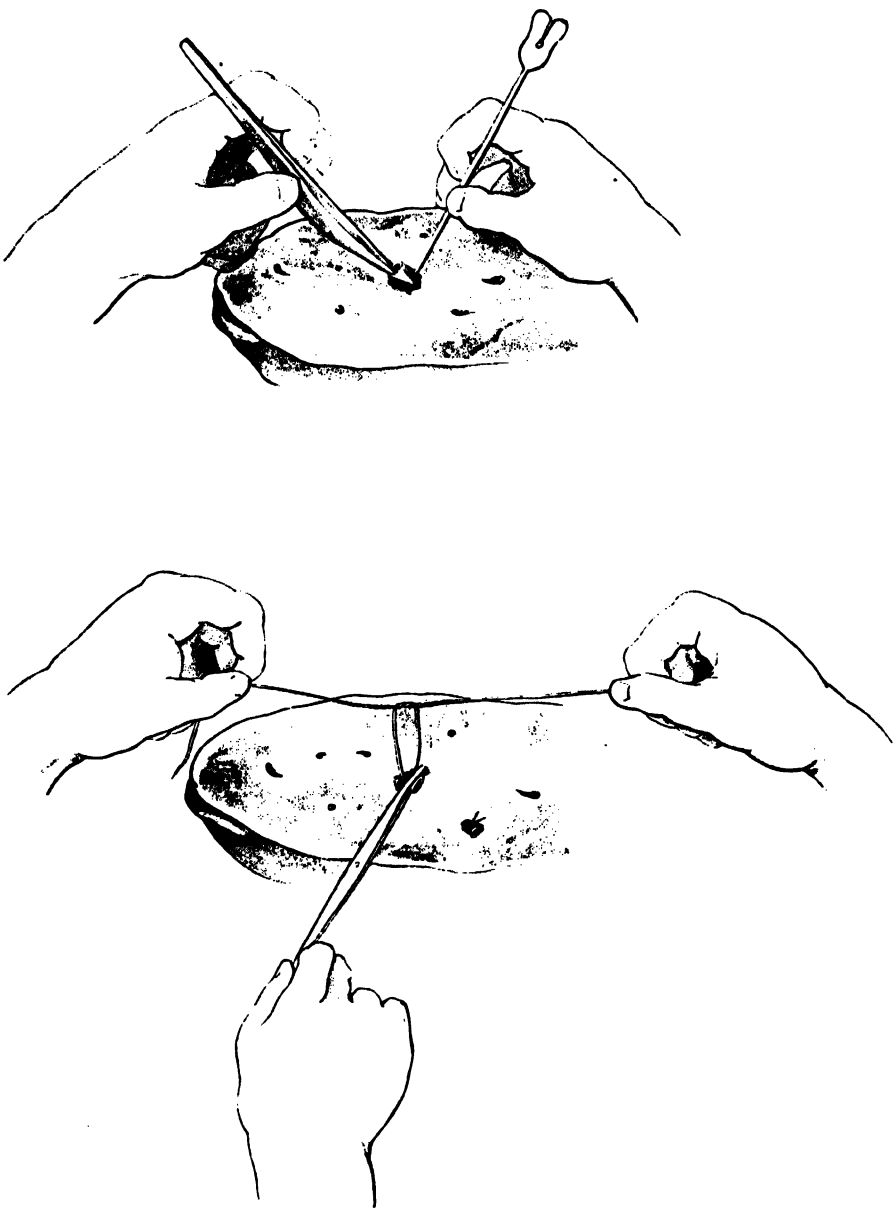


Fig. 229.—Ligation of vessels on the cut surface of the liver (Kousnetzoff and Pensky).

the chief bleeding points may be seized with a fine clip or an artery forceps, and ligated in exactly the same manner as vessels elsewhere. The walls of the veins are sufficiently strong to carry a clip and to bear the strain of a ligature.

These observers pointed out that when, in the ordinary manner, a sharp needle is passed through the liver substance, there is bleeding along the track the needle takes. This is due to the wounding of the vessels that lie in the path of the needle. They, therefore, devised a blunt, supple needle, of the type of a Hagedorn needle, which should be pushed aside by, rather than transfix, the vessels that it meets. This needle has been modified by Kader and by Mikulicz, and in any of its forms is, without doubt, the best instrument wherewith to suture the liver substance. In passing the needle it is held near the eye and the tip is "wriggled," as it were, from side to side, so that it may the more readily find a way through the soft liver substance, and avoid, in its passage, any of the branches of the portal vein.

Kousnetzoff further shewed that a thick suture material was to be preferred to a thin. Thin catgut or thin silk cuts readily through the liver, dividing all, or many, of the vessels which lie in its way. A stout ligature, on the other hand, crushes the soft substance away from its grip, but leaves the vessels, which are therefore secured. This point was taken advantage of in resection of the liver, as will be presently described.

Sutures should be used whenever possible. Even in cases where a complete closure of a wound in the liver cannot be effected, one or more sutures may be introduced and will lessen considerably the size of the rent.

Failing the suture, the only satisfactory method of dealing with wounds of the liver is, in my judgment, that in which gauze packing is used. Sterilised gauze or iodoform gauze is packed into the crevices of the wounds with sufficient firmness to arrest bleeding. In all contused wounds, extensive lacerations, or gunshot wounds, this method is almost certain to be necessary.

The use of the thermocautery is not a satisfactory method of arresting hæmorrhage from a rupture of the liver.

If blood or bile has escaped into the peritoneal cavity, means must be taken to secure that all parts are made clean before the abdominal wound is closed. The free mopping with sterilised gauze or flushing with saline solution may be necessary. The abdominal wound must always be left open sufficiently to afford an easy escape of fluids from the damaged parts.

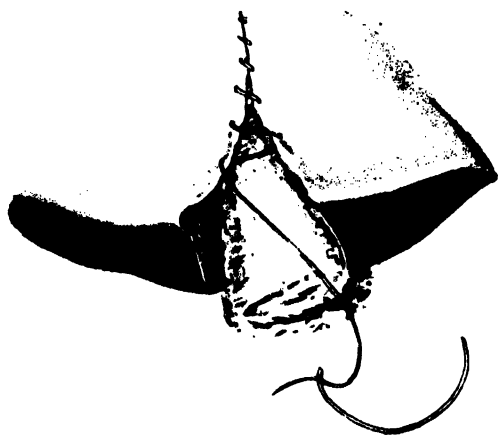


Fig. 230.—Kousnetzoff and Pensky's second method of liver suture.

RESULTS.

It is very difficult to arrive at a sound conclusion with regard to the results in cases of rupture of the liver, owing to the facts that all cases are not reported and that other injuries more or less serious than that suffered by the liver are present.

Edler's statistics, published in 1887, shew a mortality in gunshot wounds of 39 per cent., in stab wounds, of 37.5 per cent., and in subcutaneous wounds, of 78.1 per cent.

The statistics of Terrier and Auvray are based upon the reports of 45 cases, all submitted to operation. There were

11 cases of rupture with 5 deaths; 14 cases of gunshot wound with 4 deaths, and 20 cases of stab wounds with 5 deaths. The death-rate of all cases was represented by a mortality of 30 per cent., as contrasted with a mortality of 66 per cent. in the cases collected by Edler.

Benjamin Tilton ("Annals of Surgery," January, 1905, p. 27) has collected the records of all the cases treated in the New York hospitals in the last ten years. They are 25 in number, and are divided as follows: ruptures 12, gunshot wounds 9, stab wounds 4. Death occurred in 11 cases—a mortality equivalent to 44 per cent. The cases treated by early laparotomy were 20 in number, with a mortality equivalent to 40 per cent. The mortality in cases of rupture that were operated upon was 62.5 per cent.; in cases of stab wounds, 33 per cent.; and in cases of gunshot wounds, 28.5 per cent.

CHAPTER XXXV.

INJURY OF THE GALL-BLADDER AND BILE-PASSAGES.

When the gall-bladder or bile-ducts are diseased or distended behind a block due to a stone, to stricture, or to pressure from without, rupture is more likely to occur than when all the parts are sound. The number of recorded cases of rupture is small. Desrosiers, in a thesis published in 1894, collected the records of 25 cases. Of these, 13 were due to a fall on the abdomen, 10 were due to a blow, 1 was the result of a run-over accident, and 1 the result of a buffer accident.

In all cases extravasation of bile occurs, and may be limited or diffused. The limitation is generally due to the fact that adhesions have been formed and have confined the later, more abundant, effusion to a comparatively small area. The amount of bile extravasated varies considerably: only a few ounces may escape; in one case, recorded by Uhde, there was no less than 14 litres.

Jaundice is met with very frequently when the gall-bladder or any part of the bile-ducts is ruptured, and but rarely when the liver is injured. In rupture of the liver Ludwig Mayer found that jaundice was present only in 4.75 per cent. of cases. Desrosiers, in cases of rupture of the ducts, found jaundice to be present in 65 per cent. In the majority of cases the jaundice appears during the first few days, but in some records it is stated that no jaundice was noticed until the third week. Courvoisier has suggested that it may be possible to distinguish between a rupture of the gall-bladder and a rupture of the ducts by observing the intensity of the jaundice and the amount of bile which is discharged into the intestine. If the jaundice is deep and no bile is found in the fæces, and the urine contains a large quantity, the probability is that the hepatic or common duct

is ruptured. If, on the other hand, the jaundice is comparatively slight and the motions are found to be bile-stained, the probability is that the gall-bladder is ruptured. Theoretically this test is of value, but I am not aware that it has ever proved of service in practice.

It is rare to find that death occurs speedily after a laceration of the ducts. In the series of 25 cases collected by Desrosiers, 13 patients died; of these, 3 succumbed within a few hours as a result of other associated injuries; 10 died after the lapse of a few days from causes—peritonitis, toxæmia, etc.—directly attributable to the implication of the ducts.

The symptoms which are aroused seem to depend in no small measure upon the degree of infectivity of the bile which escapes into the peritoneum. When the bile-passages are healthy and normal bile escapes, the damage done to the peritoneum is slight and is tardy in onset; when, however, as is not seldom the case, the bile is septic as a result of long-standing disease in the bile-passages, inflammation is rapidly started and spreads apace.

In rather more than half the recorded cases there is a slow development of a limited swelling in the immediate neighbourhood of the liver. This swelling contains bile and is sometimes described as a "cyst"; a clear indication of the completeness of its separation from the rest of the abdomen.

OPERATION.

Operation may be resorted to immediately after the accident, though this is rarely the case, indeed, is never the case, unless extensive damage has been inflicted elsewhere—to the liver or stomach or to some part of the intestines. Or it may be considered necessary to operate only after the lapse of several days. The fact that so many patients have lived for seven to twenty-one days before the results of the accident proved fatal is a striking indication that operative treatment should in such circumstances prove successful. The methods of treatment are two:

1. Aspiration of the localised swelling.

2. Abdominal section.

1. **Aspiration** has been very frequently performed; in some cases, as in one related by Kirmisson, a single tapping has sufficed to cure the patient; in other cases the tapping has been repeated on many occasions. The conditions which exist in these cases have been proved at operation and at autopsy to be these: there is a cavity containing bile which has escaped from the rent; the cavity is everywhere shut off from the general peritoneal cavity by a stout barricade of lymph. Into this cavity bile for a time flows freely, but in the course of a few days a lymph deposit occurs around the torn edges of the gall-bladder or duct, and in a short time the rupture may be sealed off, as it were, and the further escape of bile prevented. The search during operation for a rupture under these circumstances may be one of immense difficulty, and it may in the end be fruitless. The treatment by aspiration has, therefore, been accorded a considerable degree of favour. In Desrosiers' series, 12 cases were treated by aspiration, with 4 deaths. In Terrier and Auvray's series there were 18 cases of aspiration, with 8 deaths.

The operation of aspiration is practised in the usual manner.

2. **Abdominal Section.**—In all cases where the bile is infected there can be no question that operation is imperative; for such, aspiration alone is without value. The abdomen is opened at the most prominent part of the swelling. In the majority the incision will fall upon the upper part of the right rectus muscle, at or near its outer border. The peritoneum is opened, and the fluid contained therein is allowed to escape. A view of the cavity is then obtained, and that which at once strikes the surgeon is the abundant deposit of lymph. So copious may this be that it may be difficult or even impossible to make out the position or the extent of the damage which has been done. A careful scrutiny of all parts is made, and masses of lymph are, if need be, gently detached. The conditions found are dealt with as seems best.

If no definite laceration is found, the cavity is drained with a large split-rubber tube.

If a rupture of the gall-bladder is found, it may be sutured, or the opening may be utilised for purposes of drainage, or, finally, cholecystectomy may be necessary. Before the gall-bladder is removed the surgeon must assure himself that the common duct is free. One case is recorded where death ensued eighteen days after the performance of cholecystectomy and the common bile-duct was found blocked by a large calculus. If a rupture of the hepatic or common duct is found, an attempt should be made to draw the ends together, at least in a part of their circumference; into the aperture which remains a drain may be introduced. A slight laceration of either duct could be treated by suture or by drainage, as after choledochotomy. In complete rupture of the common duct Terrier has suggested that the divided ends should be ligated and cholecystenterostomy performed. This method, however, is less satisfactory, and has less to recommend it, than the method of approximation by suture with drainage; but the difficulty of finding the distal end may be insuperable. In two cases, indeed, this end has not been found even after a postmortem dissection of the parts has been made (Porter, Stierlin).

(See "Lancet," vol. i, 1906, pp. 148, 149).

CHAPTER XXXVI.

OPERATIONS FOR HYDATID DISEASE OF THE LIVER.

In the great majority of cases an hydatid tumour of the liver can be, and must be, approached through an abdominal incision. In rare cases an operation through the pleura may be performed, after resection of two or more ribs, as suggested first by Israel; but this route possesses no advantages, and is fraught with infinitely greater dangers than the former.

During the years in which an abdominal operation was very properly considered as a most serious measure a number of alternative procedures for the treatment of hydatid cysts in the liver were suggested. Of such were aspiration, aspiration and injection, and electrolysis. These methods, however, simple though they seemed, were shewn to be by no means devoid of danger. Graham relates that 3 cases, treated by aspiration, died of syncope and shock. And other disasters, such as acute suppuration of the cyst, peritonitis, wounding of large vessels, were by no means unknown. Moreover, it became generally recognised that though the instant benefit of such treatment was often striking, the full story was not told; recurrence, or rather recrudescence, was constantly observed. For these reasons, and for the reason that the methods of abdominal surgery were daily becoming simpler and safer, all these modes of treatment were abandoned. To-day the operations practised are two:

1. Incision and drainage, in one or in two stages.
2. Enucleation.

1. INCISION AND DRAINAGE.

(*a*) **In One Stage.**—An incision is made over the most prominent part of the tumour; at the first the opening into the

peritoneum should not be more than an inch or two in length, and increased length should be obtained by continuing the incision in what seems to be the most necessary direction. As a rule, the incision is vertical, through, or by the side of, the upper part of the right rectus muscle. As soon as the peritoneal cavity is opened a detailed exploration to disclose the exact conditions present is made. It should be found that the most projecting portion of the cyst lies under the incision. Around the liver, as it is exposed in the bottom of the wound, a number of large swabs are packed. To do this satisfactorily requires the expenditure of time and pains. The liver is gently pulled aside and the abdominal wall raised, while, one by one, the swabs are placed in position. When the peritoneal cavity has been adequately protected, a large swab on each side covers the edges of the abdominal wall, so that the cut edges are not soiled by contact with any escaping fluid.

An aspirating needle of large size is now introduced into the cyst and as much fluid as possible is drained away. The needle may be partly withdrawn and thrust in two or three different directions, a fresh quantity of fluid flowing on each occasion. As the cyst is partly emptied its walls become flaccid, and the fingers, grasping them, may pull the cyst well up out of the abdomen. By the side of the needle an incision is now made through the cyst-wall, the needle is withdrawn, and the index-finger of the left hand is at once pushed onwards into the cyst. The cut edge of the liver, if of any thickness, may bleed, but in almost all cases the hæmorrhage is slight and is easily arrested by pressure or by a few sutures of catgut. The finger in the cyst now loosens any daughter cysts that may be felt and brings them to the surface for removal. A clip may be attached to each edge of the incision in the liver, so that forward traction may be made on to the cyst, and any possible trickling of fluid therefrom be prevented. The index-finger is also used to hook forward the liver and to cause it to keep in close contact with the abdominal wall, which, at the same

time, may be depressed by an assistant. An attempt should now, or at an earlier stage, be made to detach the endocyst from the ectocyst, by seizing it with a pair of long clips or with sponge forceps. When one part has been loosened it is easy, as a rule, to follow this up by traction and gauze stripping, or by the gentle twisting of the clip which has secured a hold. No force is needed in this manipulation,—force, indeed, should be avoided,—for a rent may be made in the liver which will prove to be a serious complication.

As the contents are emptied, the cyst contracts, and it becomes, therefore, an easier matter to detach the daughter cysts and to roll off the endocyst. If the means already mentioned do not suffice, some help may be gained by flushing the cyst freely with sterile salt solution at a temperature of about 100° F.

The cyst is now emptied as far as possible. Its cavity is then packed with one or more rolls of sterile gauze, to prevent leakage, while the liver is sutured to the abdominal wall. A few interrupted sutures of catgut are passed through the cut edges of the liver and the parietal peritoneum and the muscles or fascia outside it. As the stitches are passed the gauze swabs introduced at the beginning of the operation are, one by one, withdrawn. A continuous catgut suture may be used instead of interrupted sutures—with either a firm and close approximation is secured.

When all the protective swabs are removed and the suturing of the liver is completed, the rolls of gauze with which the cyst cavity has been packed are withdrawn, and the largest sized rubber drainage-tube is passed well into the cavity. A gauze drain, in addition, may be necessary, more especially if there is any hæmorrhage; as a rule, however, the tube alone suffices.

The wound in the abdominal wall may be narrowed by one or two sutures above or below.

Drainage from the cyst, if this has been completely emptied, is usually scanty at the first, but may increase after a brief

period. The fluid is almost always bile-stained from the first. In one case Delbet noticed a free escape of bile into the cavity after enucleation of the endocyst. He was able to recognize the bile-duct from which it came and to close it with a ligature.

The amount of bile contained in the discharge varies greatly; it is not infrequently fairly considerable, while in a few recorded cases there has been an escape of all the bile by this route. The fæces are then clay-coloured. Terrier ("Rev. de Chir.," 1906, p. 26) describes "cholerragie partielle" and "cholerragie totale."

At each dressing a free irrigation with some mild antiseptic (weak iodine lotion is as satisfactory as any) or with sterile salt solution may be necessary. If any part of the endocyst or daughter cysts have been left, they may be cleared away as opportunity offers. Suppuration in the sac should not occur.

(*b*) The **operation in two stages** proceeds in exactly the same manner as in the former method until the liver is exposed. The position of the cyst, if doubtful, may then be determined by aspiration or by exploration with a fine needle. The exposed surface of the liver is stitched all round to the parietal peritoneum, so that accurate apposition between the two serous surfaces is ensured. The wound is then packed with gauze for three or four days. When the gauze is removed, it will be found that adhesions have formed all around, and that the exposed area of the liver is entirely shut off from the general peritoneum. An incision is then made through the cyst-wall and the contents are evacuated, as in the manner already described.

This method is rarely adopted nowadays. By the operation in one stage an absolute protection of the peritoneum can be ensured. The method in two stages is, however, of decided advantage in those cases in which suppuration in the cyst has occurred or when limiting adhesions between the liver and the overlying peritoneum have not formed. The method is, however, a cramping one—there is no freedom left to the surgeon

to carry his investigation or his treatment beyond the part which lies under his hand.

The operation in one stage is, of these two procedures, therefore, the method of choice.

2. ENUCLEATION (KNOWSLEY THORNTON'S OPERATION).

During recent years there has been a tendency on the part of many surgeons to perform a more complete operation than either of the foregoing. This consists in an enucleation of the entire cyst, the closure by suture of the gap and wound in the liver, followed by the closure, without drainage, of the abdominal wound.

The first operation of this kind was done by Knowsley Thornton in 1883; the second, by Bond in 1891. In 1896 Pierre Delbet advocated the more general adoption of the method, and recorded in 1898, in a thesis by Baraduc, a series of 20 cases so treated. Of these 20 cases, 18 healed completely by first intention. In 2 suppuration occurred which necessitated a re-opening of the wound. All the patients recovered. The method is known in France as "Delbet's operation." Delbet, however, was preceded, both in performance and in publication, by Posadas, whose article appeared in December, 1895. The operation, it seems to me, should be known as "Knowsley Thornton's operation," for, as will be seen in the account given below, the reasons advanced by this surgeon for his deliberate choice of the method are those which Delbet himself gave thirteen years later. In many papers this operation is described as "Bond's method," which is again both inaccurate and inappropriate. The part taken by each of these surgeons in the introduction and advocacy of the operation will be seen from the following extracts from their papers.

Knowsley Thornton ("Med. Times and Gazette," 1883, vol. i, p. 89), in describing his operation, says:

"I tapped the cyst, and clear watery fluid escaped, mixed

with flakes of white, lymph-like material. I enlarged the opening, and, passing my hand into the cyst, found it packed with layers of this white material. The notion that it was hydatid was gaining ground, but from what organ it really grew was still a puzzle. As it emptied and contracted the body which I had found by touch deep in the right iliac fossa, and believed to be the ovary, came into view, and I saw that it was the gall-bladder. Other small portions of liver tissue were then found, apparently entirely isolated, in the cyst-wall. I thoroughly cleared out the cyst cavity, sponging the walls well all over. In parts they were calcareous. No fluid had escaped into the general peritoneal cavity, and, as the cyst was very adherent to uterus, intestines, etc., I decided not to attempt any general sponging for fear of causing hæmorrhage. I sewed the whole opening in the cyst into the abdominal incision, and, having taken care to thoroughly dry the sac, closed it up entirely without introducing a drain of any kind. This was an experiment, but it seemed to me that, when once thoroughly cleared of hydatids, the sac would not be a secreting one, as it had not suppurated, and if a little serum was effused into the cavity, it would gradually reabsorb as the sac contracted."

The patient recovered, and at the time the report was made she was perfectly well. In commenting upon this operation, Knowsley Thornton writes:

"In the second case the cyst was single, and seemed so thoroughly to have destroyed the liver that one wondered how the patient had lived; and yet her general health was fairly good, and it was only when the size of the cyst began to interfere with her work that she sought relief. She came to me without previous treatment, and I was able to perform an aseptic operation and to demonstrate what I had hardly hoped—that a large cavity of this kind, if not in a state of suppuration, will entirely contract and disappear, without any drainage, if it is thoroughly cleared out and left to nature without any irritant to cause secretion. It was simply necessary to remove thoroughly the hydatids, and to do this in such a manner as to avoid the admission of any of the causes of putrefaction; and in a few weeks the whole thing had disappeared, without its contraction inter-

fering with the normal action of the liver tissue which had been so long stretched out over its walls. It seems quite likely that the blood which was effused into the cavity during the first hours after the operation clotted, and aided in the consolidation of the cavity."

Bond's case was not one of hydatid disease of the liver. Two operations were performed on his patient. In the first a suppurating cyst between the bladder and rectum was incised, the lining membrane was removed, and a drainage-tube introduced. On exploring the general peritoneal cavity a small cyst, the size of a Tangerine orange, was found in a reflection of the peritoneum in the right iliac fossa. Mr. Bond writes ("Brit. Med. Jour.," vol. i, 1891, p. 795): "As I could not drain it I incised the cyst and removed the elastic membrane and clear fluid. This being a growing cyst, I also scraped away some of the inflammatory wall, but this was, I, think, unnecessary and might lead to hæmorrhage." A cyst in the epigastrium was felt, but operation upon this was postponed. Five months later the cyst had grown and operation was then undertaken. The following account is given:

"A week later I opened the abdomen by a median incision, passing through the umbilicus. I then discovered three cysts—the larger one referred to above, which lay beneath the transverse colon and omentum, and two others, the size of cricket-balls, one in the left renal region, apparently in connexion with the left mesocolon, and one quite movable at the lower part of the cavity, situated entirely in the omentum. The upper cyst was first dealt with, the omentum being gently teased away and the surface of the cyst bared; it was then tapped with a fine trocar and cannula, and most of the clear fluid drawn off without aspiration. I then drew the less tense cyst towards the abdominal wound with artery forceps, and incised it freely. On doing this I found that the white elastic cyst proper had shrunk somewhat away from the walls or ectocyst, and lay, together with daughter cysts, in the cavity; it was easily withdrawn with ring forceps, and came out quite clean, although,

from its brittleness, in several pieces. I then wiped the cavity out dry with a sponge, and allowed the cyst to fall back into the abdominal cavity. I then dealt with the other cyst on the left side of the abdomen in the same way, but the third or omental cyst was removed entirely after tapping by ligating off the portion of omentum in which it grew. I then found, on trying to draw out and fix the openings in the cysts directly to the skin, that a good deal of dragging on the abdominal contents occurred, so I simply closed the abdominal incision in the usual way, allowing two or three of the silk sutures to pass also through the cut edges of the cyst-walls; between these, two drainage-tubes were inserted, one into the lower and one into the upper cyst; but as there was very little discharge, these were removed in sixteen hours, and the abominal incision allowed to close throughout. Union occurred at once, with the exception of a small spot at the umbilicus, which continued to discharge. The temperature remained normal throughout, and in a month's time he was out of doors. Unfortunately, at this date, owing to some strain or chill or other cause, an attack of abdominal pain and violent vomiting occurred, which was followed by some discharge of pus from the incision, and Dr. Serres removed several pieces of the laminated lining of the upper cyst. This ceased in a week's time, and the patient soon became again convalescent."

Delbet pointed out, what indeed had already been well recognised by all operators, that the attachment of the endocyst to the ectocyst was by no means firm. He remarks further that in considering the cases treated by incision and drainage he was struck by two facts - *firstly*, that after the removal of a hydatid cyst which was not suppurating and which had no connexion with the bile-channels in the liver, there was at first no discharge from the cavity which was drained. The dressings were absolutely dry. A slight discharge began to appear only after the first few days, and was then probably due to a slight infection. *Secondly*, that hernia at the site of the wound was by no means infrequent after this operation. If the cavity in the liver persisted and needed to be filled with cicatricial tissue before closing up, one would expect that the

liver would remain adherent to the parietal wound and plug it, as with a cork. The fact that the liver shrank away from the wound, leaving a weak spot at which a hernia could develop, suggested to Delbet that the adventitious membrane was capable of marked retraction. The reasons which determined him to attempt a more radical operation upon hydatid cysts in the liver were, therefore, that the endocyst could always be completely removed; that the ectocyst or adventitious coat secreted little, and that this latter membrane shewed a marked tendency to retract. He planned an operation thereupon which should fulfil certain conditions:

1. The complete emptying of the cyst.
2. The removal of the endocyst.
3. The diminution of the cavity so left.
4. The closure of the opening in the liver.
5. The reduction, within the abdomen, of the liver so treated.
6. The closure of the abdominal wound.

From this procedure there was, he considered, nothing to fear, for retention of contents in the cavity was not possible, as the walls did not secrete, and infection was not likely if the cyst removed was sterile.

He put this operation to the proof on December 13, 1895.

The patient was a women, thirty-five years of age, who for four years had suffered from abdominal pain affecting chiefly the right iliac fossa; for two years she had noticed a steady increase in the size of the abdomen, and during this time she had wasted considerably and had suffered from paroxysmal attacks of dyspnœa. On examination a tumour, dull on percussion and fluctuating, was found to lie entirely below the umbilicus. On vaginal examination it was found that the tumour lay in front of the uterus. A diagnosis of ovarian cyst was made and laparotomy was performed. On opening the peritoneum the cyst presented, and it was found, on attempting to withdraw it from the abdomen, that its pedicle could be traced to the upper part of the tumour, not to the lower part, as had been

expected. The incision was, therefore, prolonged upwards, and it then became evident that the cyst sprang from the under surface of the liver, which was notably dragged down. The cyst was freely opened and emptied of its daughter cysts, and the endocyst was then stripped away. In attempting to resect a portion of the cyst-wall the gall-bladder was opened. The gall-bladder was closed by a dozen points of suture. In order



Fig. 231.—Closure of a cavity in the liver by "capitonnage"; all parts of the suture seen are continuous.

to lessen the size of the cyst-cavity a series of sutures were passed which embraced opposing parts of the cyst-wall. Several stitches were passed before any were tied. On tying them the opposing walls were brought into contact and the space between them was obliterated. The margins of the incision in the liver were then brought together by suture, and the abdominal wound was closed, a drain of gauze being passed down-

wards to the gall-bladder. The drain was removed on the fifth day. Recovery was perfect. In the second case the fluid which escaped from the cyst was at first clear, but towards the end of the flow it became bile-stained. At the bottom of the cavity an opening was seen from which bile flowed. The opening was closed by several interrupted sutures and the operation completed as in the former case. The patient made a speedy recovery. This case is most interesting as shewing that the method is applicable also to cases in which a fistulous communication exists between the cyst and the bile-passages.

For the procedure of applying sutures so as to close the cavity by causing approximation of its opposing surfaces Delbet employs the term "capitonnage."

The contra-indications to the operation are: suppuration in the hydatid cyst; extensive calcareous deposit in the cyst-wall; and profuse hæmorrhage into the cavity left after enucleation of the cyst.

The principles which underlie the operation are these: that the outer layer of the cyst is but slightly vascular, and that if the separation of the cyst is effected along the exact outer limit of this membrane, between it and the adventitious covering formed by the liver, that is, between the ectocyst and the endocyst, hæmorrhage will be scanty or absent; that contraction of the cavity left after removal of the endocyst is both speedy and complete, and that, as proved by those cases in which drainage has been adopted, the secretion from the walls of the cavity is absent or scanty.

The abdomen is opened, the cyst exposed, tapped, incised, and emptied, as in the manner already described. As a rule, as soon as the incision in the cyst-wall has been made, the cut edges may be pulled sufficiently forward to lie in or outside of the abdominal wound. The endocyst is now separated with great care and gentleness. It is seized at some spot where it has been loosened, and is gently drawn away from the ectocyst; it may, if necessary, be washed away with a fairly powerful

stream of sterile salt solution. As soon as it is completely removed, the whole of the interior of the cyst is gently "patted" with swabs until it is completely dry. Then a series of fairly strong catgut sutures are passed with a Hagedorn or intestinal needle. If interrupted sutures are used, many must be passed before one is tied, but a continuous suture is quite as efficient as, and much more easily introduced than, a series of single stitches. When the cavity has been wholly suppressed, the edges of the liver wound are sutured, the liver replaced, all swabs withdrawn from the peritoneal cavity, and the abdominal incision closed in the usual manner. The liver is not sutured to the abdominal wound.

If suppuration should follow upon this operation, it is found that in all cases yet recorded the liver has become adherent to the abdominal wall, and the pus has made its way towards the surface at the line of incision. This accident of suppuration is, however, very rare indeed, and with perfect methods may be considered as negligible.

These are the three methods which are most commonly practised. Whenever possible, the method of enucleation should be performed; it is without question the speediest and simplest, and it is at least as safe as any other method. When, however, the contra-indications already mentioned are present, then the method of incision and drainage in one or two stages may be considered.

In certain rare circumstances incisions through other parts than the anterior abdominal wall may be necessary. When the cyst projects backwards, forming a prominence between the last rib and the crest of the ilium, it may be approached through a lumbar incision. When there is an upward and backward projection, the incision may have to be made over the ribs, one or two of which are resected, and the cyst be sought through an incision in the diaphragm, through or below the pleura. The operation in these circumstances will be performed in two stages, or even, as by Israel, who first suggested it, in three stages.

There are a number of cases recorded in which the hydatid

cyst springing from the liver was pedunculated. If this condition be found, the cyst can be extirpated and a ligature or a series of deep sutures be applied to the divided pedicle. The stump of this may be returned within the abdomen or fixed in a part of the wound, and a gauze strand be passed to it for purposes of drainage, and to secure against the possible risk of hæmorrhage.

The whole subject of the treatment of hydatid cyst of the liver may, therefore, be summed up in this way:

The methods of aspiration, of aspiration and injection, and of electrolysis have been abandoned.

For cysts which are suppurating the method to be chosen is undoubtedly that of incision and drainage in one or in two stages: in one stage, if adhesions are present between the liver and the abdominal wall; in two stages, if no adhesions are present. The method in one stage is, however, quite commonly adopted, even when no adhesions are seen.

If the cyst lies at or near the surface of the liver, the method to be preferred is undoubtedly that of enucleation. It fulfils all the essentials of a satisfactory operation, and the convalescence of the patient is much more rapid than after any other operation. In rare cases the cyst must be approached by other incisions than the usual one through the anterior abdominal wall. The incision may fall upon the lumbar region or upon the chest-wall, in which case a resection of two or more ribs, usually the eighth and ninth, will be necessary.

GRAFTING OF HYDATIDS DURING OPERATION.

In dealing with hydatid cysts by operation it is important to bear in mind the possibility of the grafting of the hydatid upon any exposed surface. This possibility has been repeatedly denied, and as often reaffirmed. Recently Quénu has again emphasised the likelihood of its occurrence, and has cited observations by Ricard, Routier, Michaux, Tuffier, and Broca in support of his statements. Experiments carried out by von

Alexinsky seemed to prove the point beyond dispute; and they have been confirmed by Devé ("Thèse de Paris," 1901). Devé and Quénu have urged that the possibility of infecting the wound during operation should compel us to employ some method of killing the scolices before the evacuation of the cysts is begun. Devé writes: "The only preventive measure which renders it possible to avoid a secondary postoperative crop of the echinococcus is the killing of the germ within the cyst by an intracystic injection before the opening of the cyst for the evacuation of its contents." He suggested the use of corrosive sublimate and of formol. The latter was selected for trial in the first case operated upon by Quénu. The strength of formol used is 1 per cent., and the quantity, 300 to 400 grammes, according to the size of the cyst. The technique is described by Quénu ("Bull. et Mém. de la Soc. de Chir.," 1904, p. 956) as follows: "An incision is made over the most projecting point of the tumour, the openings through the muscle being between 4 and 5 cm. in length. The cyst is exposed, punctured with a fine needle, and the formol injected. After about four or five minutes the cyst is opened and cleared of daughter cysts and the endocyst is removed. The opposing sides of the cavity are approximated by suture and the opening into it is closed. As a rule, the wound in the liver is secured by one or two stitches to the parietal wound." The sterility of the fluid evacuated from the cyst and from the daughter cysts was proved by a large number of experiments carried out by Devé.

In an interesting discussion at the Society of Surgery in Paris ("Bull. et Mém. de la Soc. de Chir.," 1906, vol. xxxii, pp. 42–50) several of the speakers mentioned that this method of the preliminary sterilisation of hydatid cyst was always used by them.

CHAPTER XXXVII.

HEPATIC ABSCESS.

If in any case there be doubt as to whether or not an abscess of the liver be present, the doubt must be cleared away by an exploratory puncture. If pus be found, it should be evacuated at once by a free incision, and drainage should be facilitated by the introduction of a large tube. Aspiration is allowable only as a diagnostic measure; it is not to be generally commended as a therapeutic resource, though some surgeons of great experience prefer it to any other method. I quote the following paragraph from Sir Patrick Manson's work on "Tropical Diseases" (p. 369), because it seems to me to represent, as accurately as possible, the attitude which the surgeon should adopt in his investigation of a case.

"To facilitate aspiration, as well as the subsequent operation, if such should be found to be necessary, the patient ought invariably to be placed under an anæsthetic. Unless in very special and exceptional circumstances, it is a mistake to attempt exploration without this, for the surgeon ought to proceed with deliberation and to feel himself at liberty to make as many punctures as he may think necessary. A medium or full-sized aspirator needle should be used, as, owing to the nature of the pus, it may not flow through a cannula of small bore.

"If there are localising signs, such as a tender spot, a fixed pain, localised bulging, localised pneumonic crepitus, pleuritic or peritoneal friction, these should be taken as indicating, with some probability, the seat of the abscess and the most promising spot for the exploratory puncture. If none of these localising signs are present, then, considering the fact that the majority of liver abscesses are situated in the upper and back part of the right lobe, the needle should, in the first instance, be inserted in the axillary line in the eighth or ninth interspace, about an inch or an inch and a half from the costal margin, and

well below the limit of the pleura. The instrument should be carried in a direction inwards and slightly upwards and backwards, and, if found necessary, to its full extent. If pus be not struck, the needle must be slowly withdrawn, a good vacuum being maintained the while, in case the abscess has been transfixed and the point of the needle lodged in the sound tissue beyond. No pus appearing in the aspirator, the remainder of the dull hepatic area must be systematically explored, both in front and behind, regard being had for the lung and pleura, on the one hand, and for the gall-bladder, large vessels, and intestine, on the other. The peculiar colour—often like dirty-brown, thick blood—of liver pus must not be allowed to deceive the operator into thinking that he has failed to strike the abscess.

"At least six punctures should be made before the attempt to find pus is abandoned. Provided there is complete absence of breath-sounds, of vocal fremitus, and resonance over the lower part of the right lung, and pus has not been reached from lower down, then the pleura or lung may be disregarded and puncture made anywhere below the line of the nipple and angle of the scapula, or wherever the physical signs suggest.

"The surgeon should be encouraged to make early use of the aspirator by the fact that its employment, even where no pus is discovered, is not infrequently followed by rapid improvement in all the symptoms; many such cases are on record. Hepatic phlebotomy, as Dr. George Harley designated the removal, from the liver, of a few ounces of blood by the aspirator needle, is a measure of proved value in hepatitis. With due care risk from hæmorrhage is small; it is very small, indeed, in comparison with the risk of allowing a hepatic abscess to remain undiscovered and unopened.

"It is hardly necessary to add that strict aseptic precautions, in the way of purifying the patient's skin, the surgeon's hands, and all instruments, must be carefully observed."

INCISION.

Details of the Operation.—When the pus has been localised, relief must be afforded to it by the shortest path. As a rule, the incision is made vertically through the rectus muscle or

parallel to the costal margin. If the upper and hinder part of the liver is chiefly affected, it will be necessary to expose the abscess through an incision in the chest-wall.

The *abdominal incision* having been made, the peritoneal cavity will be opened in the majority of cases; in some fortunate instances adhesions will be found, shutting off from possible contamination the peritoneal cavity. If no adhesions are present, it is desirable to insert a series of sutures, or a continuous suture, which, on the one side, picks up the capsule and some of the substance of the liver, and, on the other, the parietal peritoneum and a part of the rectus muscle. A large area of the liver is then exposed in the bottom of the wound. In some instances the fixing of the liver to the abdominal wall need not be carried out until the abscess has been emptied. The peritoneum must then be walled off with a thick barrier of gauze pads. It is said that the pus from an hepatic abscess is often sterile, and that a little leakage of it into the peritoneum is harmless. This is bad teaching and worse practice. No surgeon is entitled to assume that dirty work of any kind is harmless. The barrier of gauze is an admirable safeguard against the soiling of the peritoneum. When the liver area is thus isolated by gauze or by stitches, an incision is made into the abscess cavity and the pus is allowed to escape. In some cases the cautery may be used to make the incision through the liver, but a small cut with a scalpel and the instant introduction of the finger has seemed to me the simplest method of effecting an opening. The abscess cavity is emptied as far as possible, and a large drainage-tube is introduced (Fig. 232). Some surgeons—Zancarol and Fontan are the chief among them—have advocated the free scraping of the interior of the abscess cavity. They claim that there is a more rapid healing as the result of the entire removal of the loose and shaggy lining of the abscess, which is prone to rapid decomposition. Fontan operated upon 21 cases by the ordinary method, with 17 recoveries; and upon 31 cases, in which curetting was performed, without a

death. Zancarol records 151 cases, with 74 recoveries. There are perhaps exceptional cases where this procedure may seem in the special circumstances to be desirable, but as a routine procedure it is to be condemned.

Resection of Ribs.—If one or more ribs are to be resected in order to obtain access to the pus, the incision must, if pos-

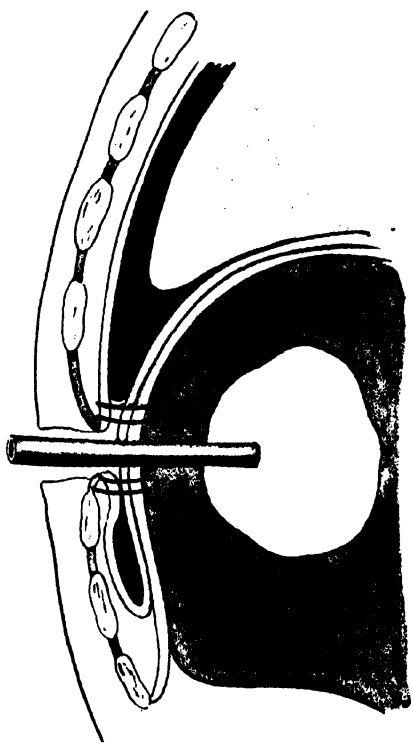


Fig. 232.—Transpleural drainage of an hepatic abscess (after Godlee).

sible, be made so low down on the chest-wall that the pleura is not likely to be opened. As a rule, this is avoided by keeping within a limit of 2 inches from the costal margin. If, however, the abscess has reached a higher level, the pleural cavity will have to be opened. The precautions which have been already described for shutting off the cavity and securing it against any contamination must be scrupulously observed.

The possibility of the presence of more abscesses than one in the liver must not be overlooked. These may, perhaps, be discovered at the time of the original operation, or they may make their presence known at a later stage by the recrudescence of the earlier symptoms. In many cases it has been possible to empty the one abscess from the other. When the original abscess has been emptied, the protrusion of an adjacent abscess has been felt; such an one may be opened by the pressure of the finger or by a puncture with a bistoury. The difficulties in these cases are sometimes extreme, and to illustrate them I cannot do better than quote the following case, which is recorded by Mr. Godlee ("Brit. Med. Jour.," vol. i, 1890, p. 63):

"E. S., a Bohemian Jew, aged thirty-six, had been resident in Kimberley for eight years, and had enjoyed good health there, without fever or dysentery; but he developed intermittent fever on his way home at Madeira, in July, 1883, and this continued for two weeks after his return to Germany. It was then absent for three months, but returned in April, 1884, accompanied by pain in the right lobe of the liver, and this continued, with slight intermissions, until May 7. The patient was attended by Dr. Dunbar Walker, of Notting Hill, and had seen Sir Wm. Gull and Sir Joseph Fayrer. By this time the liver reached down to the umbilicus, and an abscess was obviously pointing at the epigastrium. He was stout, flabby, of a muddy colour, with a foul tongue and a weak pulse, and a temperature varying from normal in the morning to 102° or 103° in the afternoon. I opened the abscess, after ascertaining the presence of adhesions, and evacuated about half a pint of disagreeably smelling yellow pus. There was a good deal of bleeding. The temperature was normal for all the next day—but on this day only; it afterwards began to rise in the afternoon, the patient always becoming much worse at this time of day; and by the seventeenth it had again a range of from normal to 103°. The pulse was weak and rapid—110 to 150; the tongue, coated and dry, though he continued to take milk. The bowels acted freely, and the motions were plentifully bilious, but the abdomen was distended with gas. Thus, though the abscess behaved quite well, the

discharge being sweet and small in amount, we felt sure he had another. Accordingly, on the fourteenth, a week after the first operation, at Sir Joseph Fayrer's suggestion I first punctured the liver just below the ribs, a little outside the first opening, and, failing to find pus at three inches, I passed the needle through the seventh or eighth space at the lower part of the axilla and drew out three or four ounces of yellow pus from a depth of four inches. The wound was then enlarged, and, using the cannula as a guide, dressing-forceps and the finger were passed into the abscess. This caused terrific hæmorrhage, and I was obliged, in the weak state of the patient, to plug the wound. Two days later I removed the plug and introduced a long tube, which appeared to drain the abscess satisfactorily for a time. But the general state showed no improvement, and ten days later a fine trocar was passed deeply through the lateral wound and evacuated a quantity of pus, probably a third abscess, though this is not quite certain. But none of these evacuations did the patient the slightest good, and on June 3, nearly five weeks after the first operation, he died, and though we could not obtain a postmortem examination, I have no doubt that his liver was riddled through with abscesses."

TREATMENT BY ASPIRATION AND SIPHON DRAINAGE.

Mr. James Cantlie, who speaks with high authority upon the subject of hepatic abscess, prefers the method of aspiration and siphon-drainage to any other. He writes ("International Clinics," vol. iv):

"Having ascertained the presence of pus, what is the next step? There are two courses open—one is to reach the pus by a 'cutting' operation, another by 'trocar and cannula.' I have thrown in my advocacy with the latter method, and as my experience increases the more convinced am I that for *deep-seated* abscesses of either the suprahepatic or intrahepatic variety it is by far the better. It will be noted that the arguments which I subsequently advance are in connexion with *deep-seated liver abscesses*, not abscesses which actually bulge either towards the abdominal wall or at the ribs, so that the pus is close to the surface. The abscesses have in these instances been left so long that the pus has burrowed its way to the surface, and the

so-called 'operation for liver abscess' is merely setting free subcutaneous pus. Therefore I debar all the treatment of such advanced abscesses being considered as 'operations for liver abscess.' Nature has in this instance saved life—not the surgeon, who has done his best to sacrifice it, for the abscess should never have been allowed to advance so far. With abscesses allowed to attain such unjustifiable proportions it matters not which operation is undertaken, and cutting is perhaps the better. With such subcutaneous collections of pus I am not dealing, but with deep-seated pus which does not bulge either towards the anterior abdominal wall or towards the right lower intercostal spaces.

"The chief argument against the employment of the trocar and cannula is that it is 'unsurgical,' whatever that may mean; and the advocates of this use of the knife declare that any other method is 'timid' surgery, that they like to have a 'good view of what they are doing,' and that they like 'to look their enemy in the face.' These are not scientific arguments, but mere statements, and flavor of surgical braggadocio. My chief objections to 'cutting' operations are:

"1. The severity of the operation is calculated to cause a practitioner, especially if he is single-handed, as often happens in tropical countries, to defer it until too late in the disease. To cut down by way of the chest, the pleura, the diaphragm, and the peritoneum to reach a (suspected) abscess of the liver is a line of treatment that the patient, if he knows anything of the operation contemplated, is apt to shrink from, and even the medical practitioner prefers to try every available resource before condemning his patient to so severe an ordeal. This hesitancy to perform a laparotomy or a transthoracic operation may cost the patient his life, and is one of the chief causes of the high mortality attending upon liver-abscess operations. Again, hepatic abscesses occur for the most part in tropical countries, where skilled help may not be available, where trained nurses are unknown, where the appliance for surgical procedures of the 'cutting' kind may be but few, and where, therefore, 'heroic' operations do not commend themselves and can be undertaken only at great risk to the patient.

"2. 'Cutting' operations, either by transthoracic or by laparotomy methods, are 'overheroic.' There is no necessity for

submitting the patient to so severe an ordeal. Neither practice nor results justify these heroic measures, and I have no hesitation in declaring against them. The men whose opinion I most value in this connexion, as well as my own experience, declare in favor of the milder method; and, even though I may be accused of surgical cowardice, I still believe that I am doing the best for the patient.

"*Operation by Trocar and Cannula and Subsequent Siphon-drainage.*—When a liver abscess is suspected, pus ought to be sought for without delay. This is done by introducing the hollow needle (not longer than four and a half inches) of an aspirating syringe or of an aspirator into the liver. If pus be not found at once, the needle may be inserted again and again —say, six or more times —into the liver in different parts.

"In my opinion the pus ought never to be sought for unless the surgeon is prepared to operate at once should pus be found. In many hospitals and in the private practice of many physicians it is customary first to search for pus, and, should it be found, to ask a surgeon to operate at a later date. This is a dangerous and unjustifiable procedure. If the physician wishes a surgeon to operate, the latter should be at hand ready to do so the moment pus is discovered; for, were a thin-walled abscess near the liver surface to be pricked in one or more places by a needle, the pus might quickly escape thence into the peritoneal cavity. Even after pus is found it is well to introduce the needle in one or two other places in the vicinity in order to ascertain the 'lie' of the abscess, so that it may be drained from the lowest part. Never introduce the same needle by which pus has been found into another part of the liver, or, at any rate, do not reintroduce the needle until it has been cleaned; the reason is obvious.

"When the abscess has been found, incise the skin at the seat of the needle puncture for about three-quarters of an inch, to admit the trocar. The trocar and cannula to be used should be not less than one-third of an inch in diameter and have a stem four and a half inches in length. Plunge the trocar and cannula into the abscess, maintaining the direction travelled previously by the hollow needle. Withdraw the trocar and stop the flow of pus through the cannula by placing the thumb over its mouth, as it is unwise at this stage to allow the abscess cavity to empty itself completely.

"Through the cannula introduce an india-rubber tube half an inch in diameter and nine inches long; this may be done by stretching the tube upon a metal rod with a small end hook at one side, in which the rubber tube is caught so that it can be stretched. The tube has, of course, several holes cut in it at the end intended to be pushed into the abscess. When the tube and the rod in which it is stretched touch the bottom of the abscess cavity, withdraw the cannula over the stretched tube; then allow the tube to contract towards the bottom of the abscess and remove the metal rod. The drainage-tube is now in the abscess, and some four or more inches project from the side of the patient's chest. The tube may be cut short, but I prefer to leave it long and to establish siphon-drainage by inserting into its projecting part one end of a piece of glass tubing of suitable size and three or four inches long, the other end of which fits tightly into a rubber tube of sufficient length to reach the bottom of a bucket standing by the side of the bed. The bucket should contain enough carbolized water to cover the outlet of the tube, and into this the pus drains. A weight ought to be attached to the lower end of the tube, to prevent slipping or displacement. The operation is completed by stitching the tube to the skin where it issues from the chest, and covering the wound around it with wet antiseptic gauze.

"The subsequent treatment consists in keeping up the drainage until the fluid that issues, as seen through the glass tube, is no longer purulent or flocculent, but merely bile-stained. If, at any time, pain in the shoulder or side is complained of, raise the bucket off the floor until it is nearly on a level with the bed; this lessens the severity of the siphonage, which probably caused the 'drawing' pain. As pus disappears stop drainage and shorten the tube, reducing its size as the discharge gradually ceases."

CHAPTER XXXVIII.

RESECTION OF THE LIVER.

THE INDICATIONS FOR OPERATION IN CASES OF TUMOUR OF THE LIVER.

THE experimental work of Glück and Grimm, the elaborate investigations of Kousnetzoff and Pensky, and, later, of Auvray, Frank, Payr and Martina, and others, have shewn that removal of even large portions of the liver can, with suitable methods, be accomplished with complete success. Resection of the liver is, therefore, a legitimate surgical procedure with which it is the business of every surgeon to make himself familiar. The number of cases, however, in which resection is possible or is likely to be attended with either instant or remote success is very small. The knowledge which we possess of the exact nature of tumours of the liver, from inspection only, is but slight. In many recorded cases a tumour removed has been supposed to be of a particular nature, —cancer or sarcoma, —yet future investigation by the microscopist has shewn that the original diagnosis was wrong. In one case Wagner removed a growth of the liver which proved to be a gumma, and the patient died of hemorrhage, a circumstance entirely lamentable. There can be no doubt, however, that, as with the stomach, increasing operative experience will enhance the surgeon's power of discrimination, and that, at the least, simple tumours will be distinguished unhesitatingly from malignant growths.

When the tumour is exposed, resection should be undertaken only when the tumour is primary and solitary, when its margins are clearly defined, when it is quite certain that the whole of the tumour can be removed, and in malignant cases that such a margin can also be cut away as to make it probable that recurrence will be prevented or will be long postponed.

In simple cases resection should not be undertaken unless there are disabilities due to the growths which are, or are likely to become, of greater account than the risk of operation. Gummata should not be removed unless calcification or other degenerative changes in an advanced stage are discovered. Kousnetzoff and Pensky, for some amazing reason, advocate the resection of syphilomata in the liver, but there can be no hesitation whatever in condemning unequivocally such an opinion. In the majority of cases resection has to be performed when the growth in the liver is in the neighbourhood of the gall-bladder and is secondary to the long-continuing irritation of gall-stones.

There are a few instances of removal of Riedel's lobe recorded. The necessity for such a procedure is extremely rare.

THE OPERATION.

The whole problem in cases of resection of the liver has turned upon the question of the control of hæmorrhage from the wound. In order to secure bloodless resections several methods have been suggested. Chief among them are the following:

1. **The First Method of Kousnetzoff and Pensky.**—These observers have elaborated, by numerous experiments upon animals, a method for the resection of malignant or simple growths of the liver. Professor von Mikulicz has practised the operation with success in man, and I am indebted to his assistant, Dr. Willy Anschütz, for a demonstration of the method.

The growth of the liver is exposed by a free incision, and the general cavity of the peritoneum is walled off with swabs in the usual manner. The purpose of the operation is to pass a series of sutures through the liver at a line well beyond the limits of the growth. After the stitches have all been tightly drawn and the tumour isolated, the liver-substance is divided between the line of ligatures and the base of the tumour. There is no bleeding from the cut surface. The liver is replaced, a packing of gauze passed down to the raw surface, and the abdominal wound partly closed.

The sutures through the liver are passed by needles of special patterns in the following manner:

A curved Kousnetzoff needle armed with stout silk with equal ends is passed through the liver from the upper to the lower surface near the edge at one extremity of the line which has previously been selected. The silk is drawn through the liver until about 5 inches only remain hanging out from the point of entrance. Of the two strands of silk, one may be called A, the other, B. One strand (strand A) of the silk, of the two which lie between the needle and the point of exit on the under surface, is now divided, so that a loose ligature is left, transfixing the liver. This is now forcibly but slowly tied, and a portion of the liver is thus secured.

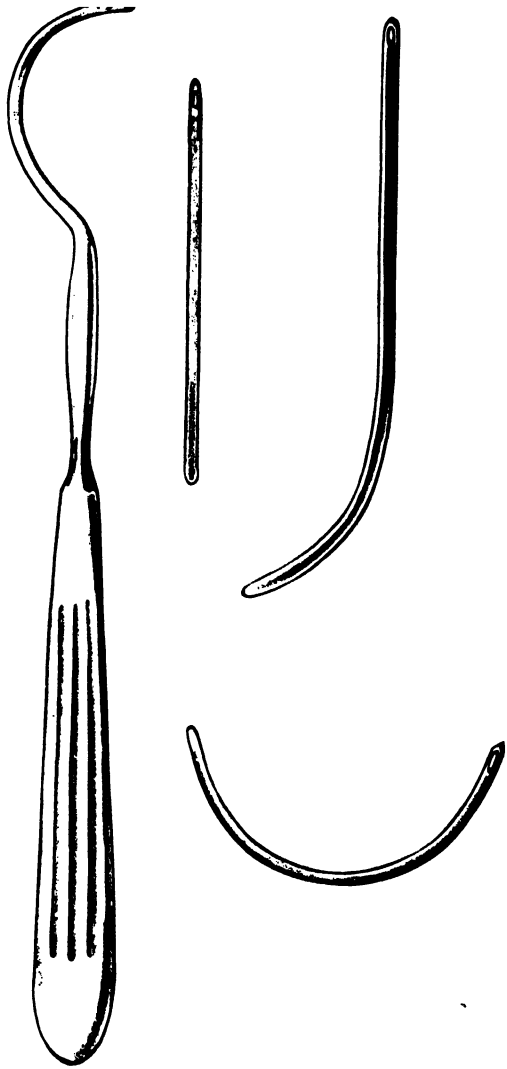


Fig. 233.—Kousnetzoff's needles for liver suture. The needles are blunt and are made sufficiently thin to be flexible.

The cut end of the silk (strand A) is now lengthened by drawing it through the needle for about 4 inches. The needle is then made to transfix the liver again

completely from the under surface to the upper, upon which it emerges about half an inch to an inch distant from the original end of the suture (strand B), which still lies loose. One of the silk strands (strand B) which lies between the needle and the liver is now divided, and care is taken to see that the one now cut is not that strand which has been cut in the under surface of the liver. The two ends of strand B are now tied on

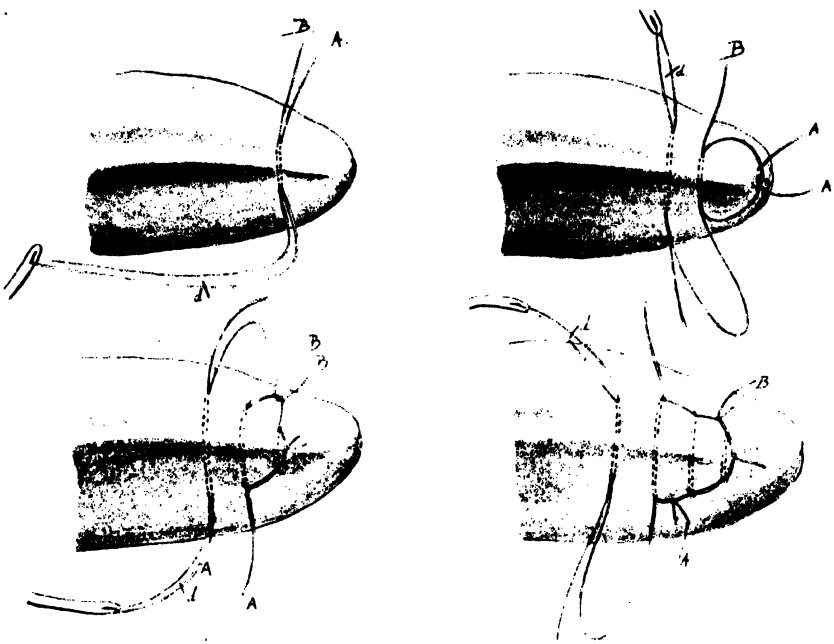


Fig. 234.—Resection of liver. Kousnetzoff and Pensky's suture. A and B are the strands of silk; *d*, the point of section of the threads.

the upper surface of the liver. The end of strand B is drawn through the eye of the needle until an end 4 or 5 inches in length is left. The needle now transfixes the liver to the under surface, where strand A is cut and tied, and so on. All the knots in strand A are on the under surface, all in strand B on the upper surface, of the liver. A verbal description of this suture is difficult to follow, but a reference to the diagram will make matters plain.

1(*a*). **Auvray's Modification of the Above.**—Auvray has mod-

ified the method of Kousnetzoff in the following manner: Through the liver, base of the lobe, or tumour to be removed a long double ligature of silk is passed with a needle which transfixes the liver from the upper to the lower surface. The silk is cut close to the needle, so that two equally long ligatures are left. A single complete turn is given to one end of these ligatures, so that they are intertwined within the liver. Each of these ligatures deals with one-half of the pedicle in the following manner: One-half of the ligature is on the upper surface of the liver; this may be called A; one-half is on the under surface; this may be called B. Ligature A remains on the surface; ligature B penetrates the substance of the liver at several points. A large, specially made needle is passed through the substance of the liver at a point about 1 cm. to the side of the original point of introduction of the ligature. When the eye of the needle (which is of the slot type so well known in Reverdin's needle) reaches the under surface of the liver, ligature B is threaded

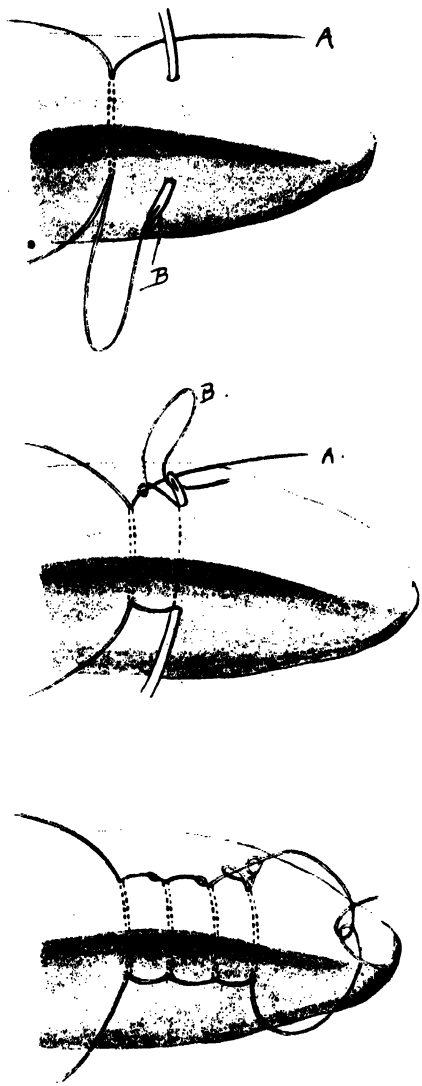


Fig. 235.—Auvray's suture in resection of the liver.

into it and pulled through by withdrawal of the needle on to the upper surface. Ligature B and ligature A are now tied together with a single knot. Considerable force is used to tie this knot, but the strain in tightening must be very gradually applied, so that the hepatic substance is squeezed away from the embrace of the ligature, and only the vessels are left. When the knot can be drawn no tighter, a second knot is tied to fix the first. Then, from the under surface of the liver, the unthreaded needle is passed in the groove or channel in which ligature B lies. When the eye of the needle reaches the upper surface of the liver, it is opened, and ligature B, threaded therein, is drawn back to the under surface. The unthreaded needle is again passed about 1 cm. from the last portion, from the upper to the lower surface, ligature B drawn upwards on it, and again tied with ligature A as before. This procedure is repeated as often as may be necessary until the edge of the liver is reached. Auvray performed this operation frequently upon dogs, and, having proved it, has since used it with success in man.

Dr. Leonard Freeman records (Trans. Amer. Surg. Association, 1904, vol. xxii, p. 196) a case of primary carcinoma of the liver upon which he operated. Interlocking gauze strips were used as ligatures in place of the usual thick silk to arrest the hæmorrhage. The following description is given:

"Operation Jan. 20, 1903. A longitudinal incision through the right rectus revealed a hard, nodular tumor of the left lobe of the liver, just to the left of the notch. It was the size of a large fist, buried almost completely in the substance of the organ, and without a pedicle. The greater portion of the growth lay beneath the free hepatic border, so that a small portion only could be felt by abdominal palpation. There were extensive omental adhesions, but no enlarged glands, and the remainder of the liver was free from involvement as far as could be detected. The gall-bladder was normal.

"After enlarging the incision it was decided to isolate the tumor by means of ligatures formed from narrow, folded strips of gauze, such as are found in every operating room. The liver

was perforated with long, blunt forceps and the strips pulled through, at first two strips, and then through each successive hole, an end of the previous strip together with a fresh one. A series of loops were thus obtained, each one enclosing a considerable amount of tissue. These were slowly and forcibly tightened and tied, thus effectually compressing the liver, but not cutting it as do ordinary sutures. Hæmorrhage from the perforation was prevented by the presence of the gauze.

"The tumour was then removed by cutting through normal liver tissue with a scalpel, no bleeding following the section except from a single vessel not included in the ligatures. After sinking the stump in the abdomen it was packed around with gauze, the ends of which, together with the ends of the strips, being brought out through the partially open wound.

"The progress of the case was uneventful except in one respect,—the removal of the gauze ligatures. The knots being buried deeply in the wound, they could not be untied or even cut with certainty. After some difficulty several strips were finally extracted; but the others resisted all efforts until bands of rubber were attached to them so as to exert constant traction, when they came out promptly and easily and without pain. At another time I should be inclined not to tie the strips, but merely draw them tight and clamp them with forceps, or tie them with catgut, thus admitting of comparatively easy extraction; but in case a strip should stick, elastic traction could still be employed.

"The patient left the hospital in about six weeks, completely recovered. On May 18, 1904, about sixteen months after the operation, he was perfectly well, with no signs of recurrence, no disturbance of any kind, and doing regular work on his engine."

In the discussion which followed the reading of this paper, Dr. W. W. Keen said:

"My experience with tumours of the liver has been limited to three cases. The first was an adenoma, the second an angioma, and the third a carcinoma, there being in each case a single tumour embedded deeply in the tissue of the liver at the anterior border.

"Judging from my experience in these cases the whole ques-

tion of the operative surgery of the liver practically is one of hæmostasis. It so happened that in these three instances I adopted three different methods.

"In the first case, the adenoma, I divided the normal liver substance just outside the limits of the tumour by means of the Paquelin cautery, and I cannot speak too highly of it. I was able in this case, by making small cuts repeatedly, to discover the large vessels of the liver readily before they were cut through by the cautery, and in each case to ligate them by means of catgut without any trouble, with practically no hæmorrhage, and then to suture the flaps thus made as if they were amputation flaps.

"In the second case I adopted a method which I do not think I should adopt again, namely, I incised the liver partially, so as to make an artificial pedicle of the tumour, tied around it an elastic ligature made of rubber tubing the size of a lead-pencil, and treated this extraperitoneally. Although no sepsis followed, and the patient recovered without trouble, yet at the same time I should not adopt it again because of fear of possible infection from the strangulated tissue.

"In the third case I used the knife, and was not as well satisfied with it as with the Paquelin cautery. It answered the purpose, however, and the patient recovered from the operation.

"The first case of adenoma I heard from several years later, and she was perfectly well.

"The second, one of angioma, recovered perfectly, and was well some months afterward, but I do not know the later history.

"The third, one of carcinoma, recovered from the operation, but I have no doubt succumbed from recurrence, which was in progress when I last heard from him."

2. **Kousnetzoff and Pensky's Second Method.**—In certain cases where the first method cannot be performed satisfactorily these observers have suggested the following:

The tumour is removed in such a manner that opposing surfaces of liver-substances can be brought together. This is done by taking a wedge-shaped portion away. Into the wound so left in the liver iodoform gauze is packed and the surfaces of the wound are pressed together on to the gauze. The capsule of the liver is now stitched along the cut margins by a con-

tinuous suture, both upper and lower edges being united up to the point where the gauze comes to the surface of the liver. The liver may be fixed, if thought desirable, to the posterior margin of the abdominal wound, but usually this is not necessary. The gauze pack is allowed to hang out of the abdominal wound, which is closed snugly around it. The gauze comes away in from ten to fifteen days and the wound then slowly granulates.

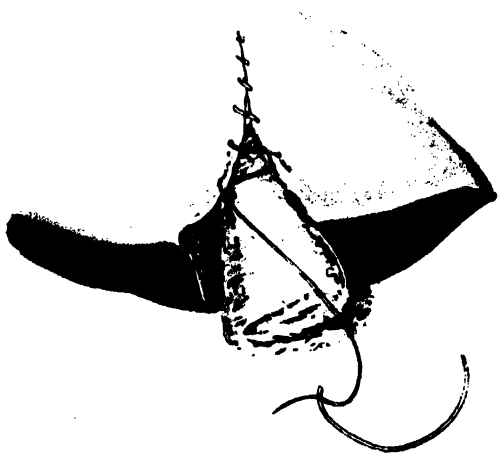


Fig. 236.—Kousnetzoff and Pensky's second method of liver suture.

This method was first put into practice by von Mikulicz in a case of syphiloma of the liver in a woman. The patient made a speedy recovery.

3. The simplest of all methods, though supposed by many to be fraught with danger, is the **excision of a wedge-shaped portion of the liver,** the ligation of all bleeding points exposed on the cut surfaces, and the approximation of the wound surfaces by deep interrupted sutures of large size. The liver, in fact, is treated in precisely the same manner as is the kidney when the operation of partial nephrectomy is performed. In two cases I have operated in this manner, with a good temporary

result, though both patients died after some months from other growths in the liver and elsewhere. As the incision is made through the liver-substance an assistant applies a flat gauze swab wrung out of hot saline solution to the cut surface and temporarily controls the bleeding. When the whole section is completed, the gauze swab is removed bit by bit and the vessels on the exposed liver surface secured with a fine clip. The vessel may then be ligated in the ordinary manner, or an armed needle may be passed beneath it, and the ligature thus buried a little in the substance of the liver.

If after making the section of the liver no arteries are seen to be pumping vigorously, the two cut surfaces are approximated, and are united by deep stitches of stout catgut passed with a Kousnetzoff needle, or an ordinary large intestinal needle. The stitches are placed about half an inch apart. When they are tied all bleeding is arrested. The edges of the wound may then be drawn together by superficial catgut sutures. The operation of partial hepatectomy, in fact, is done exactly like the operation of partial nephrectomy.

During the excision of the wedge of liver an assistant grasps the organ with one hand on each side of the wound to control hæmorrhage. This is as a rule easily secured, for the arteries are not numerous, and the blood-pressure in the portal system is low.

Jacob Frank describes ("Journal Amer. Med. Assoc.," 1905, vol. ii, p. 446) a method in which, if accurate apposition of cut liver surfaces cannot be attained, wedge-shaped pieces are removed from each lip of the wound to enable this to be done.

Dr. Rome ("Annals of Surgery," vol. xxxix, p. 98) has recorded a case of excision of the liver for tuberculosis performed in this manner. He writes:

"Exploration revealed a tumour in the lower right lobe of the liver. The surface of the liver corresponding to the tumour was firmly adherent to the parietal peritoneum. After freeing these adhesions it was apparent that the section in which the

tumour was situated could be removed in the shape of a wedge or triangle. This was mentally outlined, and heavy catgut sutures were introduced, beginning at the apex of the triangle and passed through the thickness of the lobe; the needle was reinserted and brought out opposite the first free end and left untied.

"Sutures were introduced in this manner half an inch apart and half an inch from the margin of the triangle. After inserting a sufficient number of sutures the wedge containing the growth was cut away with scissors, and the cut surfaces of the liver immediately brought together and the sutures tied. Approximating the surfaces in this way promptly checked the hæmorrhage. The size of the tumour removed was that of a goose-egg."

The cautery may be used to effect the separation of the growth.

The following case of removal of a carcinomatous lobe of the liver is worthy of record. The operation was performed by Dr. W. W. Keen, one of the most distinguished of living surgeons ("Annals of Surgery," vol. xxx, p. 267):

"Operation April 23, 1899. As soon as the abdomen was opened in the middle line it became clear that the tumour was hepatic. On drawing it outside of the abdomen I found a number of large nodules occupying the entire left lobe of the liver. My first impression was that it was a carcinoma, but later, on cutting out a piece for microscopic examination, I rather thought it possibly a gumma, or, though less likely, caseous tubercular masses. Passing my hand carefully over the rest of the liver, I found that there were no other nodules that could be discovered, nor was there any involvement of the lymphatic glands. Dr. J. Chalmers Da Costa and Dr. Geo. W. Spencer, who assisted me, reached the same conclusion as to the limitation of the tumour to the left lobe. It seemed to be possible to remove the entire left lobe of the liver and with it the whole of the tumour, and I proceeded at once to its extirpation. The operation was done entirely with the Paquelin cautery. It took from twenty to thirty minutes to sever the left lobe from the remainder of the liver. The hæmorrhage

was not very severe, excepting when I burnt into some of the larger veins. Each of these, when opened, I was able instantly to close by my left forefinger. Then, temporarily laying aside the cautery, I passed a catgut ligature under each by means of a Hagedorn needle, and one of my assistants tied it slowly but firmly. Five ligatures were thus applied. Three of the veins required ligation of both of the divided ends. The hæmorrhage, except from these large veins, was arrested by the Paquelin cautery, except that occasionally, when I laid aside the cautery

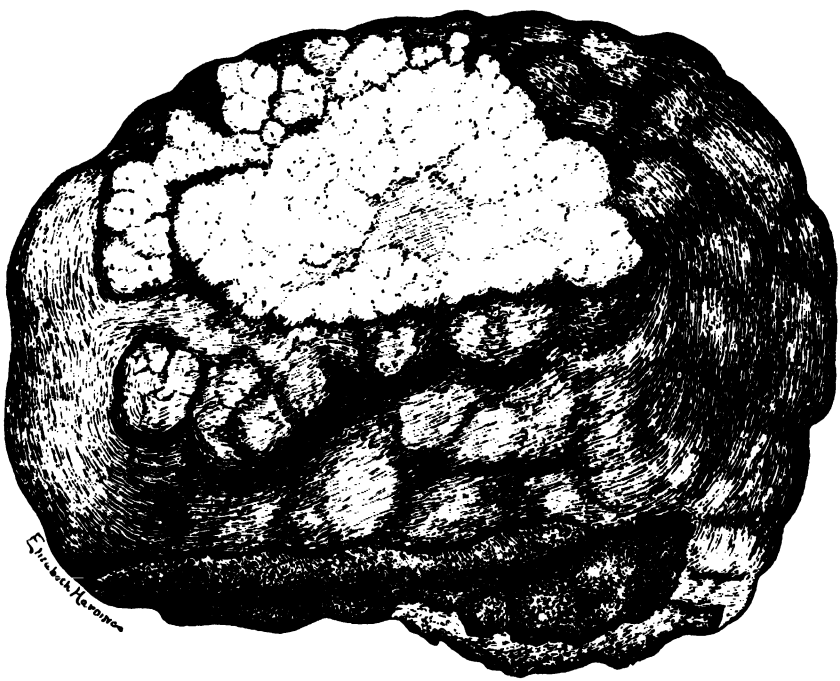


Fig. 237.—Dr. Keen's case of carcinomatous left lobe of the liver removed by operation ("Annals of Surgery").

to apply a ligature, temporary packing with iodoform gauze was of great service in arresting the parenchymatous hæmorrhage. The amount of blood lost I judged to be about eight to ten ounces; but as I feared that there might be a severe loss of blood before I got through, as soon as I began the hepatic portion of the operation Dr. W. J. Roe began an intravenous saline injection, throwing a quart of the solution into the circulation. Of course, the surrounding tissues were well protected against the cautery by wet aseptic gauze pads.

"When the tumour was removed, I found that I was able to obliterate a part of the resulting raw surface by folding the edge of the liver upon itself like the flaps of an amputation, as I had made the cautery incision obliquely. A few catgut stitches approximated these flaps, but still there was left over one-half of the burnt surface exposed in the peritoneal cavity. I feared there might be some hæmorrhage or later adhesions, and to prevent both, as well as to provide for the escape of the bile into the peritoneal cavity, I packed some iodoform gauze against the liver, leaving the end protruding through the abdominal wound. The abdominal cavity was then carefully flushed out with solution (though but few clots were thus removed), and the abdominal wound was then closed, excepting at the point where the gauze packing protruded."

4. **Removal with the aid of an elastic ligature around the pedicle.**—Resection may be carried out in the same manner as was formerly practised upon the uterus in cases of extraperitoneal treatment of the pedicle. The tumour is brought out through the abdominal incision. Through the liver near the base of the growth large pins (knitting-needles do very well) are passed, and on the proximal side of these an elastic ligature is tied as tightly as possible. The tumour is then cut away with the knife or with the cautery, and the raw surface of the liver covered with boracic powder or iodoform gauze. The following surgeons have recorded cases operated upon by this method: Lauenstein, Lucke, Terrillon, Tillmanns, Mayo Robson, Küster. The method is unsatisfactory because of the impossibility of preventing sloughing of the pedicle, and septic infection of the wound area.

Payr's Method.—Payr and Martina ("Archiv f. Klin. Chir.," Bd. 77, Heft 4, 5, 962) describe a method of ensuring hæmostasis in operations upon the liver resections, or the closure of lacerations, which has been found to answer well in practice, and in extended experimental work.

The method consists in the use of magnesium plates. Pure magnesium is a metal readily cut into the required shape by

strong scissors; but specially prepared plates of it of many sizes and shapes can now be obtained. Magnesium possesses many advantages, the chief of which are that it is absorbable, that it can be sterilised, and that it acts as a hæmostatic.

Payr and Martina suggest that their method may be found of

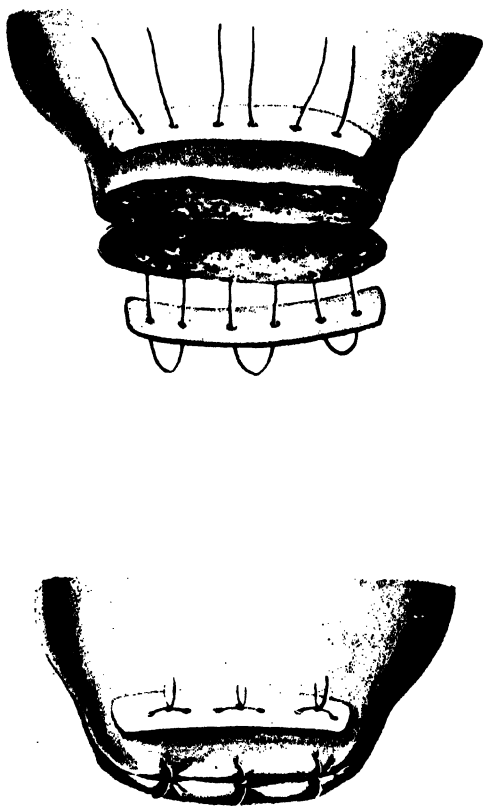


Fig. 238.—Payr and Martina's method of liver hæmostasis and suture, with the use of magnesium plates.

service in operations upon the liver and spleen, both for the repair of injuries and in the removal of tumours.

The principle consists in applying along the side of each margin of the wound in the liver a broad plate of magnesium, through which stout catgut sutures are passed. The sutures are of the

"mattress" type, so that each one traverses four holes, two in each plate. As the sutures are tightened, the plates are approximated, and the wound surfaces of the organ are brought closely into apposition. A few superficial sutures for the edges may then be introduced. The use of the plates is well shown in the accompanying drawings.



Fig. 239.—Suture of the liver with the aid of magnesium plates (after Payr and Martina).

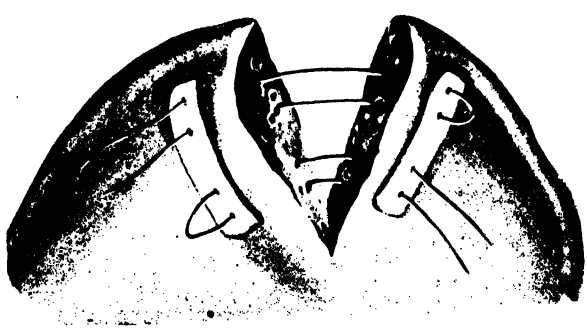


Fig. 240.—Suture of the liver with the aid of magnesium plates (after Payr and Martina).

If a large, more or less pedunculated mass is to be removed from the liver an elastic tourniquet may first be tightly applied around the base. The growth is then removed if possible by incisions enclosing a wedge of tissue so that flat surfaces of liver can be easily apposed. The plates and sutures can then be

placed in position, all the more easily that there is no bleeding from the wound areas. When the sutures are tightened the tourniquet may be removed.

It is claimed for this method that it ensures a perfect hæmostasis. Even in very large wounds there is no venous hæmorrhage, and if an artery be seen to bleed it can readily be secured by a ligature.

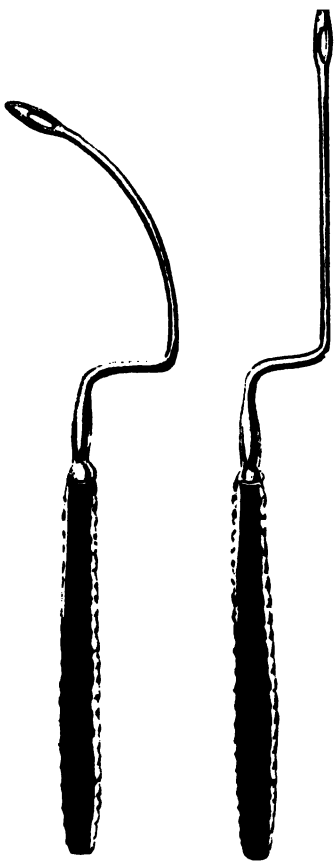


Fig. 241.—Payr's needles for liver suture.

A detailed description of the naked eye and microscopic changes resulting from this mode of treatment are given by Payr. He asserts that hæmorrhage has never occurred in any of his cases; that the liver heals well; that to the wound the omentum almost invariably becomes adherent; and that after the first hours gas is found ("gas cyst") in the tissues around the plates, which at least become completely absorbed. For all the sutures, stout iodine catgut was used. It is important that the plates should not be drawn too tightly together. Almost all the animals upon which this was done died of pneumonia. Thromboses of the veins in the wound area were found, and emboli were present in the lungs. Moreover, if pressure necrosis be produced, it is not unlikely that the "traumatic hepatic-cell embolism" (described by Lubarsch as being found in cases of traumatism to the liver) might occur.

Stamm has suggested that plates of cartilage obtained from the scapula of the calf might be used in place of magnesium. His experience is limited to experimental work upon the dog.

Ceccherelli and Bianchi (Sixteenth International Congress, Rome, 1894) used whalebone and, later, decalcified bone plates with interlocking perforating sutures in a manner which Payr and Martina closely followed.

Anschütz, in his article to which reference has already been made, gives brief extracts from the records of all cases of partial hepatectomy recorded up to 1903. The following is an epitome of the results obtained:

10 cases were treated by excision and tamponade, with	1	death.
7 cases were treated by excision by thermocautery, with	0	deaths.
25 cases were treated by excision with ligation of bleeding points and deep suture, with	2	"
6 cases were treated by clamping and excision, with	2	"
20 cases were treated by intrahepatic ligation, with	6	"
24 cases were treated by elastic ligature and pins, with	6	"

The immediate results, it will be seen, are decidedly better than might have been anticipated. Of the remote results, there is little satisfactory to say. In many of the records no information is given upon this point, but where full details are given, the frequency with which recurrence takes place is deplorable. This is almost certainly due to the fact that, as in the early days of treatment of malignant disease in all other regions, the removal of the growth has been inadequate. The fear of disaster following a wide removal has checked the surgeon and caused him to remove less of the liver than was necessary. I do not know of any case of malignant disease of the liver in which a cure has been effected by partial hepatectomy. Several cases of simple growths have made permanent recoveries. In the 52 cases related by Terrier and Auvray, only 2 died from hæmorrhage, a fact which is worthy of repetition in view of the general belief that hæmorrhage was the disaster most to be feared.

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CHAPTER XXXIX.

OPERATIONS UPON THE GALL-BLADDER AND BILE-DUCTS.

GENERAL REMARKS.

In all operations upon the gall-bladder or upon the bile-ducts a considerable advantage will be derived from the use of a sand-bag placed under the patient's back at, or a little



Fig. 242.—Shewing the position of the sand-bag in operations upon the gall-bladder and bile-ducts.

above, the level of the liver. The liver by this means is made to present in the wound, and easy access is obtained to the cystic and common ducts. The intestines fall away into the pelvis, and the whole operation area is made more accessible. In addition to this use of the sand-bag it will be found a convenience to be able slightly to tilt the table so that the head of the patient is raised and his feet lowered about four to six inches.

It is to Wheelock Elliot, of Boston, that we are indebted

for the first demonstration of the great advantage to be derived from the placing of the patient in this position. He writes:

"The patient is hung by straps under the arms on an inclined plane at an angle of something less than forty-five degrees. A sand-bag is placed under the back, so that the patient is bent over it. In this position the intestines gravitate to the lower part of the abdomen, so that when the liver is held up by a retractor, the air sucks in between the liver and intestines much as it enters the pelvis in the Trendelenburg position."

The only disadvantage of this position is that, when a vertical incision is employed, the edges of the wound are necessarily very tense, owing to the pushing forwards of the rib margin and the consequent tightening of the abdominal muscles. This solitary disadvantage is done away with when Mayo Robson's incision, to be presently described, is used. This position of the patient is, as a fact, indispensable for easy work upon the ducts.

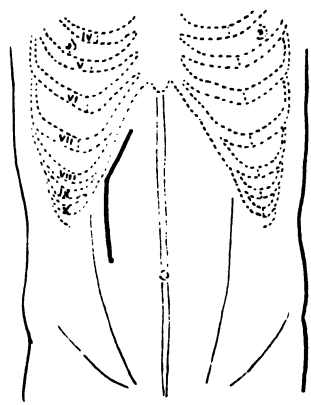


Fig. 243.—Mayo Robson's incision.

The best incision is a vertical one, made at first about four to five inches in length through the right rectus near its outer border. The upper end of the incision starts at the costal margin and extends vertically downwards. If more room is needed than this incision gives, it may be obtained by prolonging the incision downwards, or by carrying the upper end obliquely upwards and inwards, dividing the fibres of the rectus about one-half of an inch from the costal margin. There is rarely any need for a further increase of the incision than these. The incision along the outer margin of the rectus, with the upward and inward extension, is that first suggested by Mayo Robson. Great convenience may often be gained, especially in stout patients, with an abdominal wall three inches or more in thickness, by making the skin incision two or three inches longer

than the incision in the rectus. The sides of the wound then fall away and allow the more ready access of the hand. The longer incision in the skin and subcutaneous fat does not, in any way, weaken the abdominal wall, as a longer incision in the muscles would certainly do.

Dr. Arthur Dean Bevan, of Chicago, has suggested ("Annals of Surgery," vol. xxx, p. 17) the use of an S-shaped incision, the lower end of the vertical incision being carried outwards, and the upper end obliquely upwards and inwards. Dr. Bevan claims that by means of his incision less damage is done to the vessels and nerves of the abdominal wall than by other incisions,

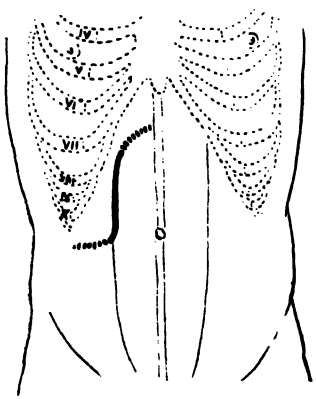


Fig. 244.—Arthur Dean Bevan's incision.

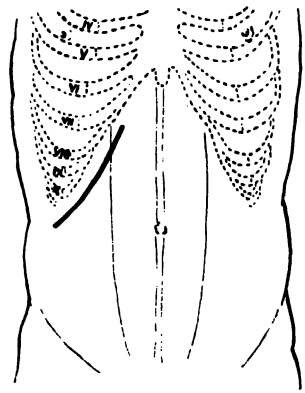


Fig. 245.—Kocher's incision.

and that a better view can be obtained of the bile-ducts. The incision of Mayo Robson is practically the same as the upper part of Bevan's incision.

Kocher uses an oblique incision four inches in length, about 1½ inches below the costal margin. The centre of the incision is a little outside the outer margin of the rectus muscle. This is a very useful incision, giving ready access to the gall-bladder and ducts, being readily enlarged either inwards or outwards, and doing little damage to the nerves or muscles of the abdominal wall. Very little weakness of the parietes remains after the operation, and there is little chance of a hernia developing.

This incision and the vertical incision, with Mayo Robson's extension, are the only ones I have adopted. So far as I am aware, I have not had a single case of post-operative hernia. This I attribute in part to the method of making the incision (a large skin wound and a small muscle wound), but chiefly to care in stitching up the wound. Courvoisier's incision is eight to ten inches in length, and runs almost parallel with the costal margin. Kehr makes use of an incision even longer than this.

Such phenomenal incisions as these two latter are never necessary. With a vertical incision, five or six inches in length, and at the most, an oblique upward and inward prolongation of this just below the costal margin, any operation can be performed upon any part of the gall-bladder or the cystic or common or hepatic ducts, provided the ducts are brought within easy reach; then the smaller the incision the better, for the intestine can the more readily be packed away with swabs or sponges. A long incision is troublesome, in that it allows the escape of intestines from the wound and makes the retention of the bowels within the abdomen a matter of constant attention. As soon as the abdomen is opened and a preliminary exploration has been made, a large flat swab is packed down towards the upper part of the right kidney pouch. The proper placing of this swab is a matter of the greatest importance. It should fill the upper part of the right kidney pouch, fitting in between the common duct and the duodenum on the inner side and the abdominal wall on the outer side. When fixed in its correct position, it forms an adequate protection against any leakage from the opened bladder or ducts. When the operation is completed and the swab is removed, there should have been no soiling of any part of the peritoneum which it covers.

A second swab of smaller size is then passed towards the middle line, to lie above the stomach to the inner side of the common duct. The exact fixing of this is also important,

though it is more easily done than is the former. A large swab is also placed so as to cover the intestines and protect them entirely. If, in very stout patients, one swab will not suffice for this, two more may be introduced.

The liver and the gall-bladder are then freed from any adhesions. These are sometimes thin, loose, and easily divided; at other times they are exceedingly tough, intricate, and difficult to separate. The greatest care and deliberation must be exercised in disentangling these. Any hurry or any undue force may be fatal; the colon or the duodenum, or even the stomach, may be torn, and leakage from these viscera may contaminate the whole field. A rough separation of the omentum

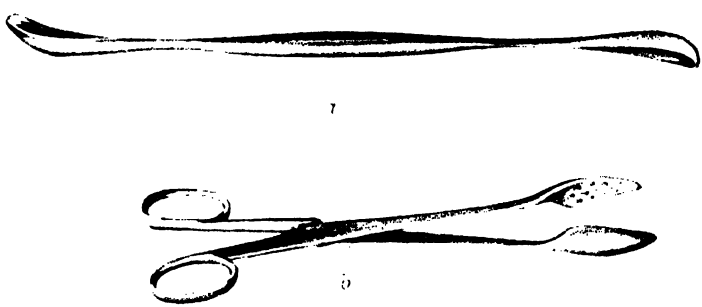


Fig. 246.—Gall-stone scoop (*a*) and forceps (*b*).

may cause a profuse hæmorrhage, and the torn vessel, retracting, may cause a large hæmatoma to form in the substance of the omentum. In the stripping of all these adhesions great help will be found in the use of gauze, which, wrapped around the fingers, slowly peels the adhesion away. It is most essential that all the ducts and the gall-bladder should be freed and laid bare before the operation proceeds further.

Unless all the bile-tract can be explored, there is a great risk of a small calculus, or even of many calculi, being left behind. Adhesions, even the very firmest, will yield to time, patience, and dexterity. No operation need ever be abandoned because the adhesions are supposed to present an insuperable obstacle. I have, on many occasions, seen adhesions that at first were

utterly bewildering in their infinite complexity; but gentle persistence in separating first one spot and then another has gradually cleared all difficulties away.



Fig. 247.—Liver rotated through Mayo Robson's incision. When the gall-bladder is pulled upwards in this way the ducts are straightened and put upon the stretch. Access to them is then quite easy.

When all is quite clear, then the gall-bladder, with the liver around it, is seized in the hand, covered with gauze, and gently dragged downwards from under the shelter of the ribs. If this

can be effected, it will be found easy to rotate the liver, turning the gall-bladder upwards, so that what was its under surface now faces upwards and forwards. By this manœuvre the cystic and common ducts are brought almost into a straight line, and the common duct, which at first seemed so deeply hidden in the abdomen, can now be brought forwards until it lies almost or actually on a level with the skin. In this way the ducts can be most thoroughly explored, and the surgeon may satisfy himself of the certainty of being able to remove all the stones.

It is not necessary in all cases to bring the liver and gall-bladder forward in this way, but in case of any doubt it is certainly advisable to do so. In thin patients this may be done through the usual vertical incision, but in the stouter patients the upward and inward prolongation of the incision will first be necessary.

In stout people it is sometimes difficult to make the liver rotate, and thus to bring the ducts forward, but even if the manœuvre cannot be completely effected, it can often be done to such an extent as to make the steps of the operation much easier. If the patient be thin, and if, as in spare women, the liver lies with its edge well below the costal margin, it is perfectly easy to bring the common duct well up to, or even outside, the abdominal wound, and there to incise or suture it.

During the operation it is advisable in all cases, but more especially in those patients suffering from chronic jaundice, to ligate every bleeding point.

After the intra-abdominal portion of the operation is completed it is necessary to remove the sand-bag from beneath the patient's back before stitching the wound. The peritoneal stitch is exceedingly difficult to introduce while the epigastrium is made tense and prominent by the sand-bag.

The preliminary treatment of patients who are to be operated upon for gall-stone disease is the same as in all abdominal operations. In cases of chronic jaundice Mayo Robson, acting upon the experimental observations of Wright, has administered

chloride of calcium, either by the mouth or by the rectum, in the hope that the coagulability of the blood might thereby be increased. I have never been convinced that this drug had any effect whatever in this direction, and though I formerly gave it a fair trial, I have now ceased to administer it. In some few cases I have given gelatine subcutaneously with the same hope, but this also I have abandoned as being useless.

The abdominal wound is closed in the following manner:

The parietal peritoneum is seized on each side with two or three pairs of clips, which hold the cut edge of the peritoneum and also the posterior sheath of the rectus muscle. The clips are given to an assistant, who holds them away from the abdominal wound with sufficient force to facilitate the ready introduction of the stitch. Too forcible a drag must not be made or the clip will be pulled away. A continuous catgut suture is now introduced, beginning at the lower end of the wound. It takes up on each side the posterior sheath and the peritoneum together. If the rectus is very thick, a portion of this may also be included. This is much better than the practice usually followed, of seizing only the peritoneum, for if there be any tension on the stitches, the needle may cut through, or the stitch, after being tightened, may break away. This stitch is continued from the lower end of the incision to the top if the wound is to be closed completely. If a drainage-tube is left in the wound, the stitch is continued up to the tube. The same stitch, having reached the upper end of the wound or the tube, is now introduced from above downwards, seizing the rectus muscle and the anterior sheath; when the lower end of the wound is reached, the end of the suture is tied to that end which was left long when the stitch was begun. The stitch is carefully introduced and accurate apposition ensured. In thin patients this suture is quite enough to ensure a firm cicatrix, but in stout patients or in any patients whom, because of old age or feebleness or old-standing chest disease, I may wish to get out of bed within three or four days of the operation, I first

introduce a series of deep silkworm-gut sutures. These are introduced about one-half of an inch from the margin of the wound; they pass through all the structures of the abdominal wall except the peritoneum, being brought out on the one side and reintroduced on the other, between the posterior rectus sheath and the peritoneum. These sutures are placed about three-fourths of an inch apart. They are not tightened until the catgut suture has been passed, as already described. When this catgut suture is completed and its ends cut short, the silkworm-gut sutures are knotted. It is not necessary—it is, in fact, harmful—to draw them very tight. As long as they draw the opposing walls comfortably together that is all that is needed. Tension is to be avoided. A continuous stitch of thin Pagenstecher thread is now introduced close to the wound edges to ensure accurate skin apposition, or Michel's metal clips are used. However carefully interrupted sutures are passed, there is a risk of having overlapping of the skin edge, and, therefore, delay in the sound and perfect healing of the wound.

THE OPERATIVE TREATMENT OF STONES IN THE GALL-BLADDER.

When stones are present in the gall-bladder, they can be removed by cholecystotomy or by cholecystectomy. The operations will be separately considered.

CHOLECYSTOTOMY.

Indications for the Performance of the Operation of Cholecystotomy.—Cholecystotomy is the operation most commonly practised at the present day for stones which are found in the gall-bladder. Under certain circumstances it has been replaced by the operation of cholecystectomy. As to the conditions which demand the latter operation, and as to those in which it will probably be the operation of choice, I propose to speak later. There are, however, certain cases for which cholecystotomy will always remain the only satisfactory operative procedure. Though the experience of many surgeons seems to be

urging them to perform cholecystectomy far more frequently

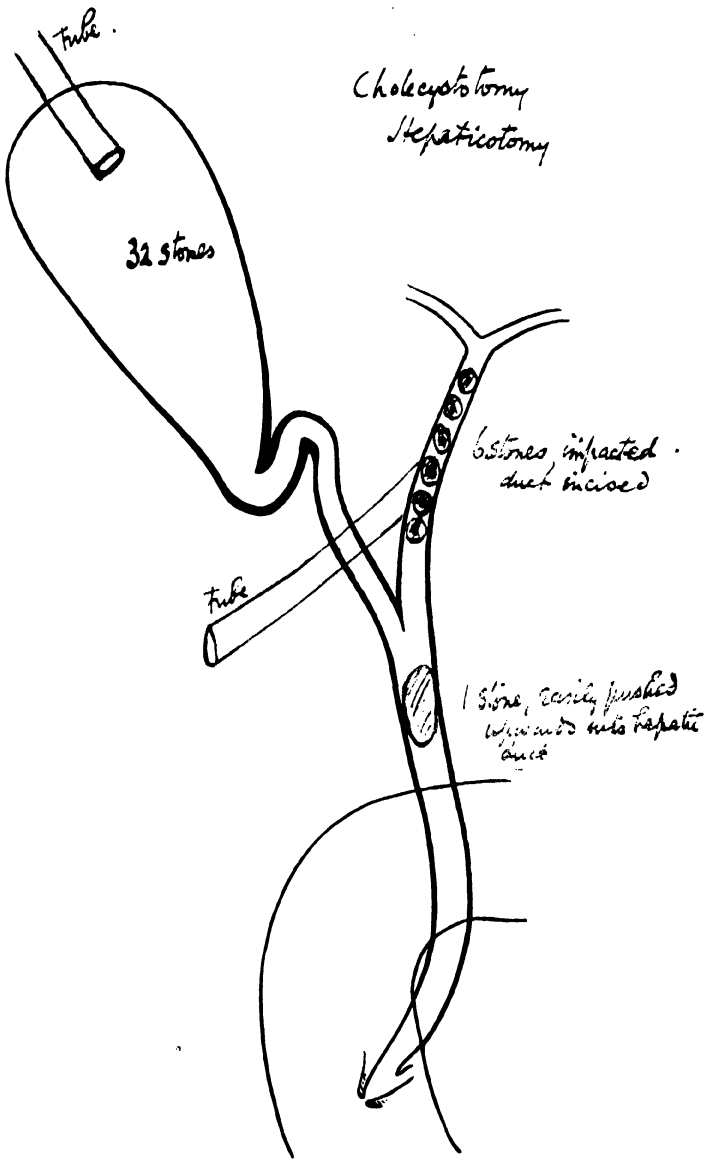


Fig. 248—I have found the annexed outline diagram, which is accurately drawn to scale, very useful in depicting, in a manner which is simple and instantly appreciable, the conditions found and the operation performed in gall-bladder or duct work. The details filled in are copied from a chart of a recent case of hepaticotomy of mine (case 1 in the text).

than before, there will always be some cases for which chole-

cystotomy must be performed. The need for this particular operation will be determined in part by the conditions found when the abdomen is opened and the bile-passages explored, but more often by the general condition of the patient. In not a few gall-stone operations, especially in older people suffering from a severe infection, that operation is the most desirable which gives the speediest relief. It is not a permanent cure of the disease that at such a moment is the surgeon's chief desire, but rather some quick and assured means of giving relief to urgent and threatening symptoms, so that the patient may be brought safely through a time of great peril. When the danger is past, then a further step towards the permanent cure of the condition may, if necessary, be safely taken. Broadly speaking, therefore, cholecystotomy will be demanded where there are the acute infective conditions for which instant relief is necessary and in patients whose powers of withstanding the shock of any detailed operative procedure are small. That surgeon will have the best results who does not *always* follow any method, but, taking a just measure of his patient's powers, chooses that measure of relief which seems to him, in each case, to be the best one in the practice of which he is the most expert. This is more especially the case in gall-stone surgery, for so many conditions, each one a menace to the patient's life or comfort, may be present at the same time. A stone in the ampulla, infectious cholangitis, cholecystitis with ulceration of stones into the liver, for example, were present in two consecutive cases of my own. For the gall-bladder condition alone, cholecystectomy would have been correct. But whether in such circumstances it should be done in the presence of the other conditions will depend upon the patient's condition, the difficulties or the ease of that particular operation, the surgeon's former experience, and so forth. In these two I performed transduodenal choledochotomy and cholecystectomy, and, after taking away the cystic duct, I left a tube in the common and hepatic ducts. Both patients recovered. To have

attempted such an operation in old or weakly patients would have been worse than folly.

One point which requires further investigation is as to the frequency and the character of the after-results of cholecystotomy. It is desirable that we should know of the frequency of recurrence of gall-stones (and this should be distinguished from the spurious recurrence which is the sequel of incomplete removal of stones) and of the symptoms that ensue when adhesions have formed to a chronically inflamed gall-bladder, even after all stones have been removed. Of the former, some evidence is forthcoming, though no doubt it is not all available; of the latter there is also evidence, and Furbringer ("Arch. f. phys. udiät. Therap.," July, 1903) has said that "post-operative adhesions to the gall-bladder embitter the lives of many patients."

The majority of surgeons will agree with Dr. Maurice Richardson when he says ("Med. News," May 2, 1903, p. 817): "The end-results in simple cholecystotomy are certainly as gratifying as end-results have ever been in any class of abdominal operations."

Operation.—The operation of cholecystotomy has been practised in two ways. In one, the gall-bladder, after being opened and cleared of stones, is stitched up and returned within the abdomen; this method is known, most inappropriately, as "ideal" cholecystotomy or as cholecystendesis (Courvoisier). In the other method the gall-bladder is opened, emptied, and stitched to the abdominal wall in such a way that drainage through the incision is permitted. The former method, first performed by Meredith in 1883, is rarely, if ever, practised by experienced surgeons now.

Since it has been recognised that many of the symptoms and all the complications of gall-stone disease are due to an inflammation in the gall-bladder or bile-ducts, it has properly become the custom to drain the bile-passages until the time, varying in different cases, when the inflammatory processes have subsided. The great principle which has to be carried

out in gall-stone surgery is drainage. Without drainage there is a risk of imperfect healing of wounds made in the bile-passages, and, therefore, of leakage subsequently of their contents, of small calculi or sand or inspissated bile, or even pus remaining, and of that condition of the mucosa persisting (stone-forming catarrh) which was responsible, in the first instance, for the formation of gall-stones. "Ideal cholecystotomy" is anything but ideal in practice, and is an operation that is mentioned now only that it may be unequivocally condemned.

Cholecystotomy is performed in the following manner: When the abdomen has been opened in the manner already described and the gall-bladder and ducts and the head of the pancreas thoroughly explored and freed from all adhesions, the operative area is packed round with gauze swabs wrung out of hot sterile salt solution. If the gall-bladder is of moderate or large size, it will be found quite easy to draw the fundus up into the wound. An aspirating needle is now thrust into the fundus of the gall-bladder and all the fluid contents drawn away. While this is done the fundus should be seized with a Spencer-Wells clip on each side of the puncture, to steady the gall-bladder and to hold it forwards when it is empty and perhaps collapsed, so that it does not slip away when the needle is withdrawn. The fluid removed from the gall-bladder should be considered septic. The needle, therefore, which has been within the bladder should not be touched, nor should any drop of exudate from the puncture be allowed to soil the hands or any portion of the wound. The swabs used to mop the puncture, or those which, in a later stage, are soiled with the fluid from the bladder, should at once be thrown away. The puncture in the fundus is now enlarged with a snip of the scissors until an opening about one-half of an inch or even longer is made. The clips which hold the fundus at each side of this incision are now removed and reapplied, so that the edge of the incision is seized. By their means the wound can now be held open, or when they are crossed over, can be securely closed. Through this opening a

large gall-stone scoop is introduced and the stones removed. If there are many stones, it is advisable to remove only a few at a time; if the scoop be overfull, it is difficult to withdraw from the gall-bladder, and some of the stones may fall away into the swabs and will have to be sought. It will often be found that if many stones are present in the gall-bladder the smaller ones will be near the fundus and one or more larger

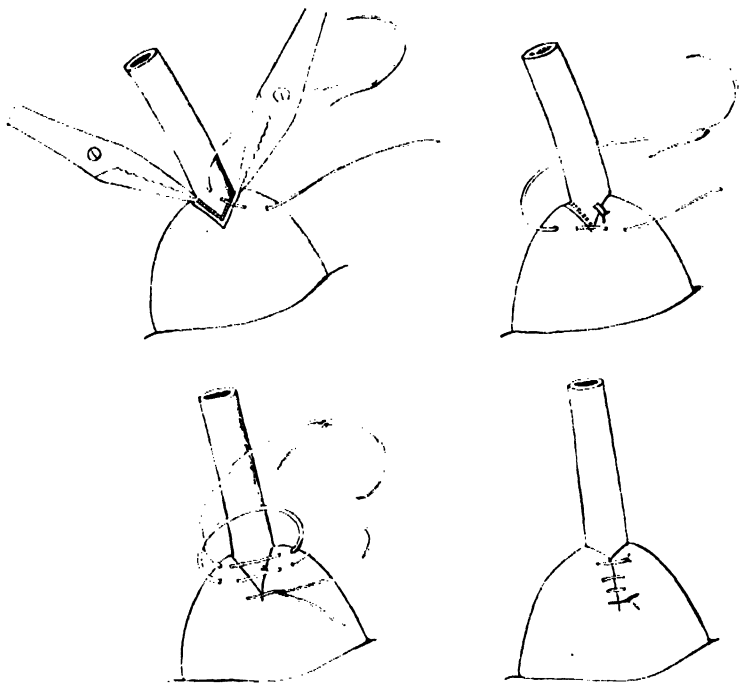


Fig. 249.—Shewing the drainage-tube fixed in the gall-bladder by a single catgut suture, and the method of infolding the edges of the wound in the gall-bladder.

ones will lie in the pelvis, near to but not occluding the opening into the cystic duct. When all the stones that can be felt with the scoop are removed, the clips on the edge of the opening are crossed so as to pull the edges together, and the fundus of the gall-bladder is wrapped in gauze. The swabs which lie beneath the bladder are then removed or pushed aside, and while the left hand holds the gall-bladder, the fingers of the

right hand are slipped along the under surface and the ducts are again explored. If a stone or stones be felt in the cystic or hepatic ducts, an attempt is made to "milk" them backwards into the gall-bladder. If any difficulty is experienced with a stone in the pelvis or in the cystic duct, the scoop may be reintroduced, and may be worked within the bladder in concert with the fingers outside. In this fashion a stone which is seemingly imprisoned may be dislodged. When all the stones are, so far as can be seen, entirely cleared away, a final examination of the duct is again made, and if it is found to be clear, the swabs may be removed from the kidney pouch and from above the stomach, one swab only being left beneath the centre of the wound. A tube is now introduced into the gall-bladder. The size most often used is about one-third of an inch in diameter. About two to three inches are laid within the gall-bladder, so that the end of the tube reaches approximately to the pelvis. The tube is now fixed by a single catgut stitch, which passes, on the one hand, through all the coats of the gall-bladder except the mucosa just beyond the edge of the opening, and, on the other, through the tube. This is tied, and the tube thereby is fixed firmly. The incision and this stitch are now buried in one of two ways: either by taking a purse-string suture around the wound and tightening this, as the tube is pushed deeper into the gall-bladder, as is done in Senn's method of gastrostomy, or a continuous stitch is taken from side to side of the incision, taking all the coats except the mucosa, so that on drawing this tight the edges are infolded as in Kader's method of gastrostomy. The stitches in either case are made to embrace the tube closely, so that no leakage can occur by

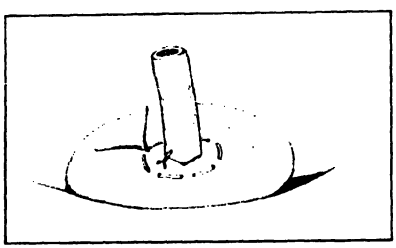


Fig. 250.—Gall-bladder closed around drainage-tube by means of a purse-string suture.

its side. The swab within the abdomen is now removed, and the abdominal wound closed in the usual manner. The gall-bladder may be allowed to fall back within the abdomen, or, preferably, it may be fixed to the parietal peritoneum in the following way: The continuous suture of catgut which is first introduced to suture the peritoneum and the posterior sheath of the rectus is begun at the lower end of the wound. When it reaches the middle or a little above the middle, the needle is passed through the wall of the gall-bladder, avoiding the mucosa as it crosses from the left to the right edge of the wound. The stitch then returns to the lower end of the wound, taking the anterior sheath of the rectus. The upper part of the wound—that which lies above the tube—is similarly treated, the stitch now beginning at the top of the wound and working downwards to the middle until the gall-bladder is reached, when, as before, a single suture is passed through it. The gall-bladder is then held by two stitches—one above, one below. There is no need to fix the gall-bladder by interrupted sutures closely placed together, or even by a continuous suture. The two stitches passed in the way described suspend the gall-bladder quite satisfactorily.

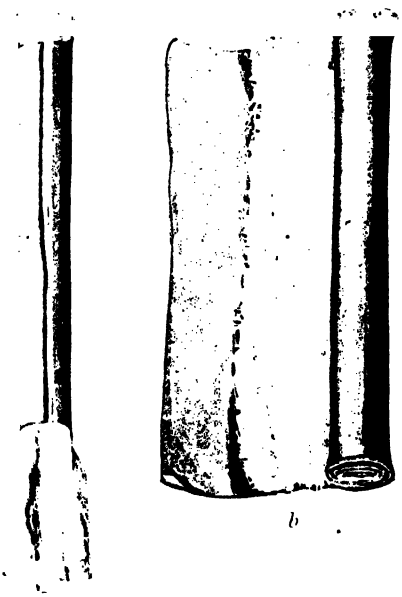


Fig. 251.—Drainage-tubes: *a*, Split rubber tube with gauze wick; *b*, the rolled tube of gauze and dental rubber.

THE OPERATIVE TREATMENT OF STONE IN THE CYSTIC DUCT.

When a stone is present in the cystic duct, it may be loosely fixed, being contained in a pouch or diverticulum, and inter-

fering very little with the passage of bile and mucus, or it may be tightly wedged in the duct and in this way may cause a condition of hydrops or of empyema, or, in the latest stage, of cysto-intestinal fistula. A stone wedged in the pelvis of the gall-bladder is not to be distinguished from a stone in the cystic duct, for, when it has been long stationary, the gall-bladder may narrow behind it, forming an "hour-glass gall-bladder," the pouch in which the stone is lying then resembling a dilated cystic duct.

When the stone is found in the cystic duct, it may be dealt with by crushing, cholelithotrity, by incision of the duct, cysticotomy, followed by suture of the duct or drainage, or by cholecystectomy, the gall-bladder and cystic duct being removed *en masse*, or by cholecystotomy.

Of the operation of cholelithotrity, whether for stone in the cystic or for stone in the common duct, I have not had, and I do not anticipate that I shall have, any experience. The method seems to me to be one that was only fitted for, perhaps compulsory in, the earliest days of the operative treatment of gall-stones. But at the present time it is rarely if ever necessary, and should be reserved only for those cases where any other method of removal seems impossible or extremely hazardous. The disadvantages of the method are that it is likely to damage the duct, and therefore, perhaps, to lead to rupture, ulceration, or stenosis; that it is uncertain,—other stones being overlooked and left untreated,—and that some fragments of the crushed stone may remain behind to form the nucleus of other stones. It is, in fact, a crude and imperfect method. The needling of a stone or stones through the duct-wall finds no place in the surgery of to-day.

Cysticotomy.—The removal of stones from the cystic duct through an incision which is subsequently sutured, or into which a drainage-tube is introduced, is an operation that is occasionally, though rarely, necessary. The operation was first performed by Lindner in 1891 upon a patient from whom he also removed the gall-bladder. Kehr, in 1892, removed a

stone from the duct and closed the opening by suture, draining the gall-bladder.

The neck of the gall-bladder and the cystic duct are exposed by the method of rotation of the liver already described. When the duct is exposed it is incised, the stone or stones removed, and a further exploration of the duct made at once. If the bile-passages are found to be clear, the wound may be closed by a continuous catgut suture which misses the mucosa. This will close the incision satisfactorily, but a second supporting layer of sutures, either of catgut or preferably of thin celluloid thread, should also be introduced. A drain is then placed in the gall-bladder and the abdominal wound is closed in the usual way.

When the stone is tightly wedged in the duct and hydrops or empyema has resulted, the operation to be practised will depend very much upon the general condition of the patient and upon the especial conditions found when the field of operation is exposed. As a rule, cholecystectomy should be performed. It is the operation I perform as the routine procedure, in the absence of special circumstances which would add an undue risk to its performance. I have removed the gall-bladder and the cystic duct upon several occasions for these conditions, and the results have been remarkably good. In seven cases of empyema I have lost one patient, on the eleventh day, from suppression of urine, and of five cases of hydrops I have not lost one, and in one case of gangrene of the gall-bladder the patient recovered.

If, however, the condition of the patient is poor and her power of bearing any operation is but small, or if the gall-bladder be adherent or the mechanical difficulties of the operation, owing to thickness of the abdominal walls, be considerable, cholecystotomy should be performed.

It will be found helpful, then, to aspirate the contents of the distended gall-bladder very slowly. If the fluid is quickly withdrawn, it will be found that the gall-bladder contracts

rapidly on to the stone and forms a tight constriction on the distal side of it. If, however, the fluid be withdrawn slowly and the operator keeps his fingers on the stone, he may be able to squeeze the stone backwards into the gall-bladder, which is still moderately distended with fluid. The gall-bladder should never be emptied until a very thorough attempt at displacing the stone has been made. This little manœuvre is one the use of which I have experienced. The reason for its success is easy to understand. The fact that the stone has been displaced, and that, therefore, the cystic duct is clear, will be appreciated when bile is seen to flow from the gall-bladder. After dislodging the stone the gall-bladder may be drained as in the ordinary method of cholecystotomy, or the gall-bladder may be removed.

If it is found impossible, after persistent efforts, to dislodge the stone, the operation of cysticotomy is performed, or the gall-bladder is drained and the abdominal wound is closed. The tube used for draining the gall-bladder should be of large size—half an inch or even more in diameter. After the lapse of a few days the stone may be dislodged spontaneously. If it is not, then the tube may be removed and the gall-bladder be syringed with hot sterile salt solution, or with olive oil or soap solutions. In one or other of these ways the stone may be displaced, or, it is supposed, in part dissolved. Even after seventeen days, as in one of my earliest cases, the stone may move into the gall-bladder and escape from the wound. A biliary fistula is then left, which closes spontaneously in the usual manner.

If the stone remains unmoved, then a mucous fistula persists. These fistulæ were much more commonly seen in the early days of gall-stone surgery than they are now. When they exist, it is for the patients to decide whether the discomfort thereby caused is great enough to compel them to undergo a further operation for their relief. As a rule, they cause but trivial inconvenience. Their treatment by operation consists in destroying the mucous membrane of the gall-bladder either

by the scraper or by the cautery, or by the knife or—and this in preference—by making a further attempt at the removal of the impacted stone, and, failing that, by performing the operation of cholecystectomy and removing the cystic duct entirely.

Treatment of Biliary Fistulæ.—If, in operating upon a patient for gall-stone disease, a fistula be found between any part of the intestinal canal, on the one hand, and the gall-bladder and cystic duct, on the other, the adherent and communicating viscera should be separated. This must be done with great gentleness, so that no unnecessary damage is done to the stomach or intestine. When a complete separation has been made, the opening into the intestine must be trimmed and its closure securely effected by suture. As a rule, a continuous suture of catgut, embracing all the coats of the gut, and outside this a continuous suture of fine Pagenstecher thread, will prove the most satisfactory method of closure. The opening in the gall-bladder or in the cystic duct may be closed by suture; it may be drained or, preferably, the gall-bladder and the cystic duct together may be removed, as in the cases under my own care to which reference has already been made.

CHOLECYSTECTOMY.

Indications for the Performance of Cholecystectomy.—In 1902 I read a paper, entitled "A Series of Cases of Cholecystectomy," before the Yorkshire Branch of the British Medical Association. I gave then the following indications for the performance of this operation:

1. In injuries of the gall-bladder, rupture, stab or bullet wounds.
2. In gangrene of the gall-bladder.
3. In phlegmonous cholecystitis.
4. In membranous cholecystitis.
5. In chronic cholecystitis with dense thickening of the walls of the gall-bladder and cystic duct, with or without stenosis of the cystic duct, and in chronic cholecystitis, when the gall-

bladder is shrivelled and puckered and universally adherent. In such cases it is no longer a receptacle for the bile.

6. In distension of the gall-bladder, hydrops or empyema, due to blockage of the cystic duct by calculus, stricture, growth, or external inflammatory deposits; or in cases of mucous fistula following operations for these conditions.

7. In cases of fistula between the gall-bladder or the cystic duct, on the one hand, and the stomach, duodenum, or colon, on the other.

8. In multiple ulcerations of the gall-bladder or the cystic duct, when gall-stones have eroded their way through the walls into the liver, the duodenum, or other protective adherent masses.

9. In primary carcinoma of the gall-bladder.

Speaking broadly, it may be said that, in cases of an inflammatory character, if the cystic duct is blocked or is so damaged by a stone as to be likely to have a stricture developed therein, the gall-bladder should be removed; if bile can pass through the duct into the gall-bladder, cholecystotomy may be safely performed.

The result of my early cases was so satisfactory that I was led to put the operation to a more extended proof, and, as my experience increases, I am tempted to ask whether it would not be the better treatment in many gall-stone operations to remove the gall-bladder entirely.

The experience of every surgeon who has worked extensively in this field of surgery is that the chief purpose and the main indication in any operation for gall-stones is the drainage of the gall-bladder and bile-ducts. Of the validity of this experience there can be no question. We know that gall-stones are rendered troublesome by the cholecystitis or the cholangitis which they are the means of arousing. In many cases it is because of the inflammatory consequences that an operation is demanded. The essential part of any operation would, therefore, seem to be the drainage of the gall-bladder, prolonged for such a time as to allow a complete subsidence of the inflamma-

tory process. But in the very great majority of cases the secondary inflammation has its origin, and runs its course, entirely within the gall-bladder; an infection of the hepatic or common ducts does not occur. In many cases, therefore, in removing the gall-bladder, we are doing away with the necessity for drainage by removing that structure the drainage of which seemed imperative.

It is within the gall-bladder that the great majority of stones are formed; it is within the gall-bladder that the secondary inflammatory troubles break out, and are, in the majority of cases, altogether limited. The removal of the gall-bladder, therefore, does away with the need for drainage. It renders less likely the inflammatory consequences of their presence. If, however, the need for drainage is absolute, it is possible—in fact, quite easy—to drain the ducts after the gall-bladder has been removed. After the division of the cystic duct the stump of the duct may be slit up until the hepatic duct is reached, or the cystic duct may be cut off flush with the common duct. It is then quite a simple matter to explore upwards and downwards with a gall-stone scoop or with the finger to make certain that the ducts are clear of calculi, and then to stitch in, by a single catgut suture, a rubber drainage-tube. The presence of stones in the common duct does not debar one from removing the gall-bladder. In two cases I have removed stones from the ampulla of Vater by duodeno-choledochotomy, and have then at once removed a chronically inflamed gall-bladder full of stones, which were ulcerating into the liver, and, after dividing the cystic duct to the common duct, have stitched in a rubber drainage-tube. Both patients recovered without the slightest interruption. The plea, therefore, that the need for drainage is opposed to the routine removal of the gall-bladder is answered by the facts that when the gall-bladder is removed, the need for drainage does not often exist, as that need was due to the presence of the gall-bladder, and that, if desirable or necessary, it can be carried out without the smallest difficulty.

An examination into the recorded cases of carcinoma of the gall-bladder and of the adjacent portions of the liver shews that in approximately 95 per cent. the malignant change is due to the chronic irritation of gall-stones. If the gall-bladder is removed there will, of course, be no chance of this malignant growth occurring. This is not, however, a point of much importance, for the cases of carcinoma are, as a rule, those in which no operation has been done; by the time the surgeon sees the cases the growth is already there. To make the argument for cholecystectomy a strong one, from this point of view, it would be necessary to shew that malignant disease occurred after cholecystotomy, and, so far as I know, this had not been done at the time my paper, already referred to, was written. Since then, however, my colleague, Mr. Lawford Knaggs, has recorded an exemplary instance of this. The case is given at length in the chapter dealing with the General Pathology of Gall-stone Disease in my book on "Gall-Stones and Their Surgical Treatment." A similar instance is recorded by Mr. Mayo Robson. The patient was a lady, aged fifty-seven, upon whom cholecystectomy was performed in February, 1902. A good recovery followed, and the patient remained well up to August, 1903, except for pain in the gall-bladder. On examination a tender lump could be felt in the gall-bladder region. On opening the abdomen a second time, in October, 1903, the gall-bladder was found the size of a small hen's egg, full of solid material. On incising it the swelling was found to be new-growth which was infiltrating contiguous parts of the liver. The gall-bladder and adjoining part of the liver were removed successfully. Cases such as these strengthen materially the plea for cholecystectomy. In two recent cases of my own, gall-bladders which were supposed to be affected only with chronic inflammation have proved, on microscopic examination, to be the seat of early malignant changes.

For a further discussion on the relationship of gall-stones to cancer of the gall-bladder see the "Lancet," 1905, vol. i, pp. 1059 and 1227.

In the very great majority of operations for gall-stones there is ample evidence of long-standing inflammation in and about the gall-bladder. The normal smoothness of the gall-bladder is gone, its deep blue colour is lost, its once supple walls have become thickened and tough. A glance at a gall-bladder during other abdominal operations will tell one in a moment whether stones are lying there. If the gall-bladder is blue, it is healthy; if opaque and grey or yellow there are, or there certainly have been, stones, and a chronic inflammation aroused by them.

In some cases, therefore, it will be conceded that cholecystectomy is the more desirable operation, but before its routine adoption is advocated it is necessary to shew that the gall-bladder is useless, and that its removal does not add any risk as compared with cholecystotomy. In the abstract one might be inclined to think that the loss of a bile reservoir capable of emptying on demand would be a serious matter to the individual, or, at the least, a disability. The perfection of the mechanism of digestion, so graphically told by Lawlow, would seem to require that bile should be ejected in spurts, as it were, into the duodenum during digestion. But there is clinical experience in abundance to shew that when all the bile is discharged from the body through an external biliary fistula, without a drop entering the intestine, the individual suffers no sign of disability of any kind. There is abundant evidence also, furnished by my own cases and by many others, to shew that the removal of the gall-bladder does not interfere with digestion; that the individual eats well, gains in weight, and to all appearance has the same duodenal digestion as an ordinary healthy individual. The gall-bladder, therefore, if not useless, can quite well be spared.

The removal of the gall-bladder in cases judiciously selected does certainly not involve a greater risk than the operation of cholecystotomy. I have, in fact, in several cases, been convinced that the removal of the gall-bladder made the operation simpler and shorter than it would have been if a multitude of small

stones had been removed. By carrying out the operation in the manner described below it will be found a safe, speedy, and simple procedure. During the last three years I have inclined more and more to the performance of cholecystectomy, and after some hesitation and some trepidation, which experience has removed, I am strongly disposed to advocate the frequent, though certainly not the invariable, adoption of this operation in preference to cholecystotomy. Its advantages are that the operation removes the chief source of the disease; that it thereby prevents, in great measure, a recurrence either of stones or of the inflammation which betokens their presence; that growths in the gall-bladder or adhesions around it are subsequently impossible, and, finally, that the wound, if drainage is not required, may be caused to heal throughout by first intention. The gall-bladder is devoid of any strikingly useful purpose, and its removal does not add appreciably to the danger of the operation. If drainage of the ducts is necessary, it can be carried out quite satisfactorily. The presence of a stone in the common duct does not prohibit the operation, but drainage of the duct, after removal of the stone in the duct or in the ampulla, is necessary.

The one disadvantage that may justly be urged against cholecystectomy is this: that if a late operation should become necessary,—for stones can, and do, form in the hepatic and common ducts,—such an operation would be more difficult and almost certainly more dangerous. The possibility of a further operation being necessary cannot be denied, but the likelihood of it is negligible.

The Operation.—Cholecystectomy was first performed by Langenbuch on July 15, 1882.

The operation is performed in the following manner: Mayo Robson's incision is made, the abdomen opened, the adhesions separated, and the liver rotated in the manner already described. The gall-bladder may be removed from before backwards or from behind forwards; that is to say, the cystic artery and duct may be first cut across and the gall-bladder stripped up

towards the fundus, or the peritoneum around the fundus may be first divided and the gall-bladder stripped up towards the cystic duct. I have adopted both methods, but prefer the



Fig. 252.—Cholecystectomy. The liver is rotated so that the gall-bladder lies outside the abdominal wound. The cystic duct and artery are seen. The wound is packed off with swabs; these are not shewn in the subsequent drawings.

former, as the only difficult part of the operation—the ligation of the pedicle—is accomplished first; in the latter the blood trickling down from the denuded area of the liver may obscure the view.

The liver being held upwards, the cystic duct and its termination in the common duct are defined. A circular peritoneal incision is now made around the cystic duct, about half an inch from its termination, and a peritoneal cuff is stripped up towards the common duct. In this way the cystic duct is cleared to the view. Two clips with a curved beak are now placed on the cystic duct, and the duct is divided between them. The clip on the gall-bladder side prevents any leakage during

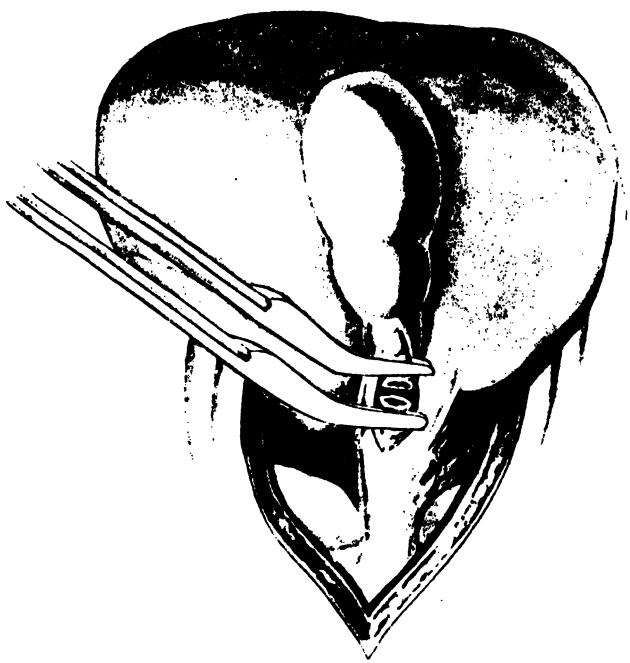


Fig. 253.—Cholecystectomy. The cystic duct is clamped between two pairs of Moynihan's forceps and divided.

the further steps of the operation. The stump of the cystic duct is ligated with catgut, and the clip on its divided end is removed. The frayed end of the duct is trimmed away with scissors. The cystic artery and vein are now defined. They lie above and to the inner side of the divided duct, and may be readily seen by gently stripping with gauze that part of the pedicle which remains. Two clips are applied and the vessels are divided between them. The proximal end of the vessels is now

ligated with catgut, and the clip which secures them is removed. Occasionally, another vessel than the cystic artery may need to be clipped and ligated; it is a separate branch of the hepatic which passes to the common and cystic ducts. If there is no inflammation of the common duct, and if, therefore, there is no need for drainage, the stump of the cystic duct may be covered completely by its peritoneal cuff, which is fixed over it by one



Fig. 254.—Cholecystectomy. The cystic duct and artery are tied, the former as close as possible to its termination. The gall-bladder is being stripped up from the liver. The cut end of the cystic duct is closed by forceps.

or two sutures of fine Pagenstecher thread. A small flat swab is then placed over the common duct, and the separation of the gall-bladder from its fossa is begun. This is most easily and expeditiously effected by working upwards towards the fundus with the index-finger, which is insinuated at first between the pelvis of the gall-bladder and the liver. The finger may be covered with gauze, so as to make the separation easier. A

little patience will soon secure that the gall-bladder is stripped cleanly away and is left attached only by a peritoneal fold around it. This fold is then divided about one-half to three-fourths of an inch away from the liver, and the gall-bladder then comes away. A raw surface fringed by a collar of loosely hanging peritoneum is now left. From this raw surface there may be some oozing. This is checked by the pressure of a swab wrung

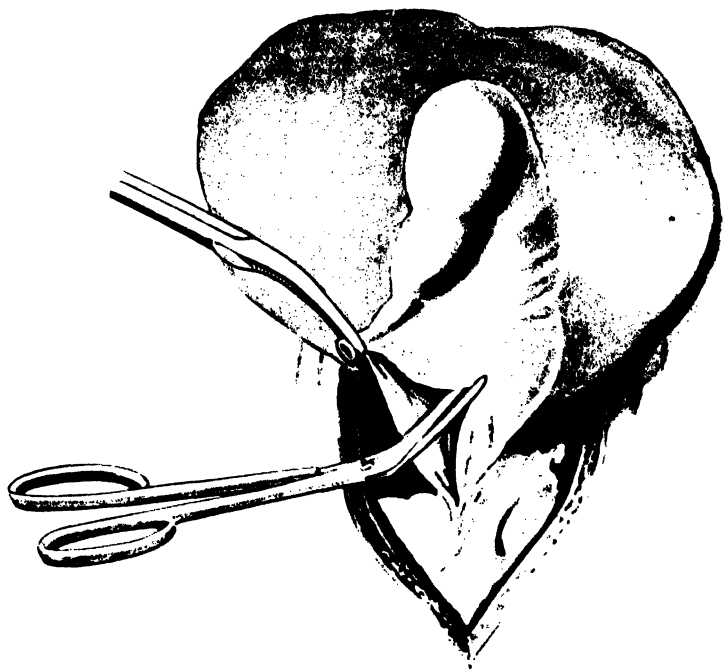


Fig. 255.—Cholecystectomy. The peritoneum is being divided between the gall-bladder, which is partly stripped, and the liver.

out of hot sterile salt solution. Rarely a suture may be necessary if any vessel bleeds. This is passed with a curved intestinal needle and tied gently. When all the oozing has stopped, the peritoneum around the denuded surface is closed over it by a continuous suture of catgut which passes from the liver-edge to the cystic duct. A final cleansing of the operative area is needed, and the abdomen may then be closed.

If, however, drainage of the common duct is necessary, it



Fig. 256.—Cholecystectomy. The gall-bladder and cystic duct have been removed. The peritoneum, stripped from the sides of the gall-bladder, remains.

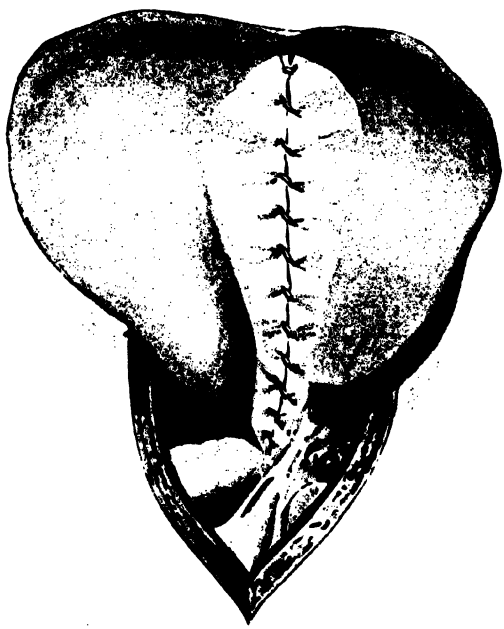


Fig. 257.—Cholecystectomy. The operation completed by suture of the peritoneum over the bared surface of the liver.

may be secured in one of two ways—either immediately or after the lapse of a few days. If immediate drainage is desired, the cystic duct is not ligated in the manner described. When that stage in the operation is reached, the clip is removed from the stump of the cystic duct, and the cut edges are seized with fine French vulsella. The duct is reached, and an opening is made into this, at its junction with the hepatic duct, of sufficient size

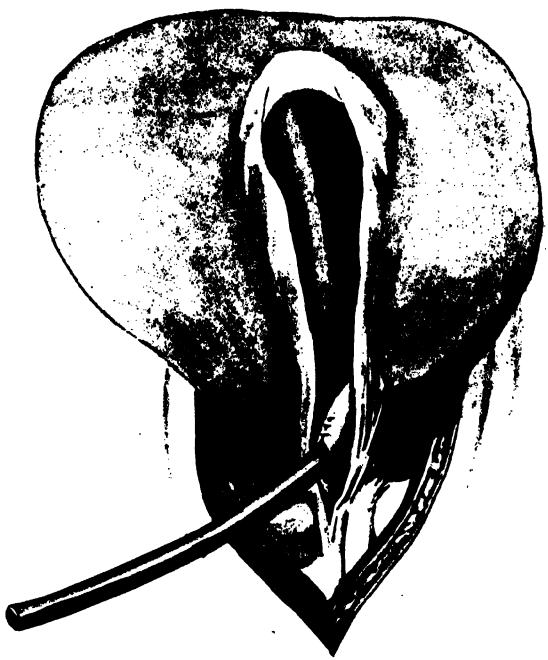


Fig. 258.—Cholecystectomy. Drainage of the hepatic duct, which, for purposes of illustration, is shewn pulled forward from its normal position.

to permit of the introduction of a rubber tube. This is fixed in the duct by a suture of catgut which picks up the wall of the common duct a little distance away from the cut edge. To the outer side of this tube a second one is placed, being split and having a gauze wick into the kidney pouch. This second tube may come through the abdominal wound or be made to project from a stab wound in the loin—preferably the former. If it is thought desirable to postpone the drainage for a few days,

the following plan, which I have found convenient, may be adopted. The clip on the cystic duct is removed and a small clip placed so that the open end of the duct is just seized. Around this a single thin catgut ligature is placed. The peritoneum is not stitched over the stump of the duct. A rubber tube is now passed down to the ligated duct, and it may be fixed by passing a stitch through it and through the peritoneal cuff. The peritoneum is not sutured over the divided end of the duct. The catgut ligature which closes the duct soon gives way, - in three or four days,—and bile then begins to flow through the tube. By this time an impermeable rampart of adhesions will have formed around the tube, and will effectually prevent any leakage into the general peritoneal cavity.

Drainage may or may not be necessary after cholecystectomy. If cholangitis be present, as in those cases where a stone is also removed from the common duct or from the ampulla, it is certainly necessary. If, however, the inflammatory changes are limited to the gall-bladder, drainage need not be provided, the whole abdominal wound being tightly closed.

LUMBAR CHOLECYSTOTOMY OR CHOLECYSTECTOMY.

In a certain small proportion of cases the opening or the removal of the gall-bladder in the loin may be deemed necessary, as, for example, when a mistaken diagnosis of renal tumour has been made and the gall-bladder has been exposed. W. P. Manton ("Amer. Med.," Oct. 4, 1902) describes a case of extirpation of the gall-bladder through a lumbar incision. The diagnosis in this case was nephroptosis with probable cystic metamorphosis of the kidney. When the kidney was brought out of the lumbar wound, the gall-bladder containing a number of stones could be easily palpated, and was so thoroughly shut off from the general peritoneal cavity, either by adhesions or because of its anomalous situation, that the operator was able to remove it, with the cystic duct, without much difficulty. The gall-bladder and the cystic duct contained nineteen stones.

Cholecystotomy Performed upon the Left Side.—Carl Beck ("Annals of Surgery," vol. xxix, p. 593) records a case of cholecystotomy in which, owing to transposition of the viscera, the liver lay in the left side of the abdomen, and the incision had, therefore, to be made through the left rectus muscle.

THE SURGERY OF THE HEPATIC DUCT.

When calculi are arrested in the hepatic duct, they may be removed through incisions made into the gall-bladder, into the common duct, or, rarely, into the hepatic duct itself, or they may be crushed and the fragments pressed onwards into the common duct. In the very great majority of instances stones which are felt in the hepatic ducts can be milked downwards and removed during cholecystotomy or during choledochotomy. In very exceptional instances, however, the performance of hepaticotomy—that is, incision of the hepatic duct—may be necessary.

Hepaticotomy.—The operation was first performed by Kocher on November 8, 1889, unintentionally and unknowingly. In the hepatic duct, which was closely adherent to the gall-bladder, a stone was tightly wedged. The duct was opened and the stone was removed. Shortly afterwards the abdomen was reopened, as symptoms of peritonitis were present. Bile was found in the general peritoneal cavity. The patient died.

Other operations were performed by Cabot (1892), Elliot (1894), Czerny (two cases), Kehr, and recently Delagénière and Rogers. Cabot's case was one in which many calculi were removed from the gall-bladder. A large stone was then felt in the hepatic duct, deep under the liver. The duct was opened with very great difficulty and the stone extracted. The duct and the gall-bladder were drained, and the patient recovered.

Elliot ("Annals of Surgery," vol. xxii, p. 86) gives the following account of his case:

"On September 4 I opened the abdomen by an incision in the upper right linea semilunaris. The gall-bladder was found

empty and flaccid; the ducts were palpated, and a stone was felt deep under the liver in the hepatic duct. The stone could not be pushed along the duct nor crushed with the fingers. No other stone was felt in the common or cystic duct. After separating numerous adhesions the stone was seized between the thumb and forefinger of the left hand and pulled up from its deep position. Adhesions and duodenum were pushed aside until the stone appeared between the fingers with only the peritoneum and the wall of the duct covering it. The field of operation was packed with gauze to prevent contamination with bile; the duct was incised, and a stone the size of a robin's egg extracted. The duct was closed at once with catgut sutures, a second row of silk sutures, including the peritoneum, being placed outside. The duct was held with the fingers, and very little bile escaped. A drainage-tube and gauze were packed down to the sutured duct. A rapid and complete recovery followed. The duct did not leak, and on the second day the gauze drain was removed. On the fourth day the abdominal wound was completely closed by provisional sutures. The jaundice had partially disappeared, and the stools were natural in colour. The patient was well in three weeks. Eight months after operation he was known to be in perfect health."

In Czerny's case and in one of Kehr's the duct was ruptured during the manipulations attendant upon the removal of stones, and the wound was closed by sutures. An interesting case of hepaticotomy is related by Leonard Rogers.

The following are the only two cases of hepaticotomy which I have performed:

CASE 1.—*Cholecystotomy; hepaticotomy; recovery.*—E. F., female, aged forty-six. The patient was admitted complaining of attacks of pain in the right side and jaundice. She has had many attacks of pain, attended by nausea, retching, vomiting, and sometimes by collapse and profuse sweating, followed always by jaundice. The first attack was four years ago, and then attacks came about every six months up to the last few weeks, when there have been several. During the last month she has had several rigors, with high temperature, vomiting, and diarrhœa. Pain

in the right side has been acute, and tenderness is exquisite. The liver is enlarged. A diagnosis of stone in the common bile-duct was made.

Operation June 17, 1905. Mayo Robson's incision. Gall-bladder found full of stones; 32 were removed. The ducts were then explored, a great many adhesions having first to be separated. The common bile-duct was clear, but in the hepatic duct a large stone was felt. A persistent effort to dislodge this failed, and an incision was then made directly over the stone, which was removed. It was about the size of a Barcelona-nut. A scoop was passed upwards in the hepatic duct, and 5 more smaller stones were removed. The finger was then readily introduced into the duct and passed both upwards and downwards but no calculi were felt. A tube was stitched in the hepatic duct, and a second tube in the gall-bladder. The patient went on well for about ten days. Then the jaundice which had lessened began again to increase; a rigor followed, and on the next day a small stone was expelled through the wound. From this time the progress was rapid and satisfactory and the patient returned home on July 18th with the wound healed.

CASE 2.—*Cholecystotomy; hepaticotomy.*—M. T., female, aged sixty. Fourteen years ago she had a severe illness, lasting some weeks, which she believes was typhoid. During this illness she had a tender swelling in the right hypochondrium and she also became jaundiced. The jaundice subsequently disappeared and, with this exception, she has never suffered from any abdominal complaint until four months ago. At that time she had an attack of severe abdominal pain of a colicky nature, most intense to the right of the epigastrium. The onset was accompanied by shivering; then there occurred vomiting, and she became jaundiced. A similar attack occurred at the beginning of this year (two months ago), another three weeks ago, and a third attack came on soon after her arrival at the Nursing Home. The attacks are preceded by a feeling of tightness and stiffness over the lower ribs on the right side. The jaundice lessens in degree between the attacks only to deepen again after the onset of pain. On examination, a markedly jaundiced woman, presenting an indefinite tender swelling projecting from the right costal margin. There is some rigidity of the upper segment of the right rectus; stools pale-coloured; urine contains a small amount of

albumen and a trace of bile pigment; the temperature chart was of the characteristic "steeple" form. Two days after admission the temperature and pulse had fallen to normal, and on the fourth day the swelling and rigidity in the hypochondrium had almost gone, while the jaundice was less, and the motions were coloured with bile.

Operation February 21st. Robson's incision. The gall-bladder was found to be thickened and packed with stones which also extended along the cystic duct. The gall-bladder was opened and numerous stones removed, the majority being facetted, about half an inch in diameter, but 2 of the calculi—one situated in the fundus, the other fitting the pelvis—were of the size of nutmegs. Further examination revealed the presence of stones in the hepatic duct. Attempts to milk them downwards into the common duct having failed, the hepatic duct was incised and several stones and some debris extracted. A probe, followed by the finger, was then passed through the gall-bladder and cystic duct into the common duct, which was found to be quite clear. Another probe inserted into the hepatic duct also met with no obstruction. The incision in the hepatic duct was sewn up with fine catgut, a drainage tube inserted in the gall-bladder, and the abdomen closed, leaving a split drainage tube passing down to the neighbourhood of the suture line in the hepatic duct. Recovery was quite uneventful.

The operation of **hepaticostomy,** or the opening of the hepatic duct, and the suture of the duct in the abdominal wound, was first performed by Knowsley Thornton in 1888. He removed 412 stones from a dilated hepatic duct which formed a swelling closely resembling the gall-bladder. The duct was stitched to the abdominal wall and drained. The fistula closed in fourteen days.

A remarkable case is recorded by H. V. Chapman. An abdominal tumour, about the shape and size of a large kidney, was felt in the abdomen; it was connected with the liver. The abdomen was opened over the tumour by an incision 13 cm. in length, between the umbilicus and the anterior superior spine. There were numerous adhesions which were readily freed. The

tumour was seen to consist of a portion of the liver near its anterior margin; at the lower part the wall was thin and seemed likely to burst. A trocar was plunged in, and 480 c.c. of lightly bile-stained fluid were withdrawn. Then, with a round needle, the tumour was stitched to the abdominal wall, and a few days later was opened and 127 calculi were removed therefrom. The case is described by Pantaloni as "transhepatic hepaticostomy." An example of "subhepatic hepaticostomy" is recorded by Nicolaysen, of Christiania. The patient was a little girl, aged eight, in whose abdomen a cyst 17 cm. long and 15 cm. broad was felt. The swelling descended about three finger-breadths below the umbilicus. A year before there had been jaundice for three months; from this the patient recovered, and attended school to within three days of her admission to hospital. At the operation the cyst was fixed to the abdominal wall, and six days later was aspirated. Death occurred one day later. The cyst was found to be formed by a dilatation of the whole of the hepatic and of a part of the common duct. The hepatic duct had been stitched to the abdominal wound. There was no tumour, and no stone could be found. Nicolaysen considered that the deformity was congenital in origin.

Leonard Rogers ("Brit. Med. Jour.," vol. ii, 1903, p. 706) records a case in which the hepatic duct was opened under the impression that it was the gall-bladder; it was brought to the surface and drained. The patient died the next day; it was then found that the hepatic duct, and not the gall-bladder, had been opened. The duct was immensely dilated behind an impacted stone.

Access to the duct may be readily obtained, as was first shewn by Elliot, by placing a sand-bag under the patient's back at the level of the liver. The manœuvre of rotation of the liver already described makes it a simple matter to expose the duct to view and to easy handling.

The operation of **hepaticolithotripsy** or the crushing of a stone in the hepatic duct is at times the safest and the speediest method of dealing with such an obstruction. It was first sug-

gested by Kocher in 1890, and has been performed by Mayo Robson, Delagénière, and recently by Marcel Baillet ("Bull. et Mém. Soc. de Chir.," vol. xxix, p. 1194). The last case was one in which choledochotomy and suture of the common duct had been performed. The symptoms were not relieved, and nine days later the abdomen was reopened and a stone, found in the hepatic duct, was crushed. The result was good.

In a case of obstruction of the lower end of the hepatic duct Quénu ("Bull. et Mém. de la Soc. de Chir.," vol. xxxi, p. 218, March 7, 1905) united the enormously distended hepatic duct to the stomach, performing the operation of *hepaticogastrostomy*. The case proved fatal.

CHAPTER XL.

OPERATIONS FOR OBSTRUCTION OF THE COMMON DUCT.

CHOLEDOCHOTOMY.

A STONE may be impacted in the common duct in any point of its course. The stone may be solitary, or there may be, and commonly are, more stones than one. A stone may be fixed in the ampulla, and a second stone, or several, may be wedged in the upper part of the duct, or even in the hepatic duct.

Access to the duct may be obtained in three directions:

1. Above the duodenum by supraduodenal choledochotomy.
2. Behind the duodenum by retroduodenal choledochotomy.
3. Through the duodenum by duodeno-choledochotomy.

First, **Choledochotomy Performed upon the First Portion of the Common Duct.**—The operation was first suggested by Langenbuch in 1884, first performed by Kümmell in the same year, and first performed successfully by Knowsley Thornton in 1889. This is the simplest operation, and in my experience has been that which I have been most frequently called upon to perform.

The position of the patient during the operation is a matter of great importance. All the steps of the operation up to the suture of the abdominal wound are simplified by placing a large sand-bag under the patient's back behind the liver, as already described. The table may be slightly tilted, so that the feet of the patient are lowered four or five inches and the head correspondingly raised. Mayo Robson's incision is made—that is, a vertical incision, about five inches in length, near the outer border of the rectus, and an oblique upward and inward prolongation from this, about one-half of an inch from the costal margin, for about two inches or more, if necessary. The abdomen is opened, the kidney and stomach swabs carefully placed

in position, all adhesions carefully separated by gauze stripping or divided and ligated, the bleeding points being carefully sought and at once ligated in this as in all stages of the operation.

The gall-bladder and the edge of the liver are now grasped in the hand, being first covered by gauze, so that a firm grip may be obtained. They are dragged gently but firmly downwards from under the costal margin, and the liver is then rotated so that the posterior surface of the gall-bladder now looks forwards and upwards, and the common duct is stretched and brought much nearer to the abdominal wall. In thin patients the common duct is brought quite on a level with the skin-wound; in fat patients this is not possible, but in all, the duct is made easy of access. It is possible to explore it thoroughly, to incise, and, if need be, to stitch it without, as a rule, any difficulty.

The common duct now being exposed is surrounded very carefully with swabs and the position of the stone defined. It will often be found to slip about in the dilated duct and to be very elusive. This is, from some points of view, a disadvantage, but it often enables the surgeon to move a stone impacted low down in the duct into the upper and more accessible portion. The stone is now grasped between the index-finger and thumb of the left hand, and the duct incised over the stone, the cut being of such size as to permit the easy removal of the stone. With a pair of forceps or with a gall-stone scoop the stone is now dislodged. Immediately after it bile will flow, and this the assistant wipes away at once, before there is time for it to soil the parts around. Such bile is always, or almost always, infected by the *Bacillus coli communis*, if not by other organisms. Any other visible stones are removed, and the scoop is passed upwards and downwards along the ducts to explore. It will always be found that the duct is of large size, partly as the result of an old-standing cholangitis, partly perhaps because of the increased tension of the bile therein. The duct will, therefore, be large enough in most cases to admit the finger, and in this way alone can a perfectly satisfactory exploration

of the duct be made. A stone that will evade detection by the scoop is at once perceived by the finger. The finger, therefore, should always be passed both upwards and downwards along the duct and a free exploration made. A stone even in the ampulla may, by the conjoined manipulation of the fingers on the duodenum and a finger within the duct, be coaxed upwards into the duct and removed.

This digital exploration should always be resorted to in common duct stone, but it must be remembered that the duct is a septic tract. A glove-finger may, therefore, be put on before the exploration, or the glove on that hand may be changed. It is often advisable to push into the duct, both upwards and downwards, a wick of sterile gauze. This, when withdrawn, will often be found to have little calculi and particles of sand or grit adhering to it. After the duct is cleared of stones two courses are open to the surgeon. He may either close the duct by suture or he may drain the duct by a rubber tube. Each case must be decided as seems best, but, on the whole, it will be found both desirable and necessary to drain.

Drainage of the common duct may be direct or indirect — direct, when a tube is introduced into the opening in the duct made for the extraction of the stone; indirect, when the duct is sutured and a drain is left in the gall-bladder or in the stump of the cystic duct left after removal of the gall-bladder. In some instances one method, in other instances the other, may seem the best. But in nearly all cases drainage by one or other of these methods is imperative. If the common duct is closed by suture and the gall-bladder drained, it is prudent, though not always necessary, to leave in the wound a wisp of gauze whose end lies against the sutured line.

If drainage is employed, a rubber tube is passed upwards towards the hepatic duct for about an inch. If the opening in the duct is very wide, it may be narrowed by a stitch or two of catgut, introduced by Lembert's method. The tube is stitched in by a single catgut suture, which picks up the wall

of the common duct a little outside the edge and passes through the tube. So long as this stitch holds—and it holds about seven to ten days—the tube will remain in place. In addition to this tube another drain is necessary on the outer side of the duct. For this I prefer a rubber tube, split longitudinally, with a fine gauze wick. The tube lies to the outer side of the duct in the kidney pouch; it may be brought out of the abdominal incision or made to present in a stab wound in the loin—preferably the former. A third tube to lie to the inner side of the duct is occasionally necessary. The gauze wick projects about two inches from the inner end of these tubes. These tubes are left in for from three to ten days, as seems necessary. There is no advantage in removing them early.

If it is deemed prudent, the common duct may be closed by suture. This is done by a continuous stitch of catgut or fine celluloid thread taken from end to end of the incision and introduced in two layers. It is important to avoid wounding or penetrating the mucosa, as any suture which gains access to the lumen of the duct may form the nucleus of a calculus. When the wound is securely closed, a split rubber tube with a gauze wick may be passed down to the duct, as a matter of precaution in the unlikely event of any leakage ensuing.

There does not seem to be any general agreement among surgeons as to the propriety or advisability of adopting drainage after the removal of a stone from the common duct. A discussion was recently held at the Société de Chir. de Paris ("Bull. et Mém. de la Soc. de Chir. de Paris," vol. xxix, p. 1194), in which several surgeons gave their experience. Michaux, in twelve choledochotomies, had sutured the duct in all, and the results were "very satisfactory." A drain was left in contact with the suture-line, and in "three or four" there was a slight escape of bile. Quénu had abandoned suture entirely, as second operations, owing to blockage of the duct by the infolded mucosa or blood-clot, were sometimes called for. Schwartz considered that suture of the duct might be responsible for certain disasters,

and he advised drainage in all cases. Hartmann considered that suture of the common duct was "always unnecessary and sometimes harmful." In my own early cases I not infrequently stitched the wound in the duct, but in a series of 22 consecutive cases I have drained the duct and all the patients have recovered.

The whole operation area is now gently wiped with sterile swabs wrung out of salt solution, and the liver is replaced and the abdominal wound closed in part or wholly, as may be necessary.

ROTATION OF THE DUCT.

There are cases occasionally met with in which, when a stone is impacted in the common duct, the condition of the patient is such that only the minimum of interference is permissible. If, in such circumstances, the gall-bladder be small, shrunken, and buried in adhesions which also surround the cystic duct, the mere separation of these adhesions may be a tedious and time-consuming process. It is more than probable that such a gall-bladder is entirely useless, and it may be cut off entirely from communication with the common duct. It is generally considered that it is impossible to reach the common duct until all these adhesions, which may involve the duodenum or the colon, are divided or separated. But by the method I have often used, for which I suggest the term *rotation of the duct*, the adhesions are ignored and the stone is yet easily removed. As soon as the condition of things is seen, the left hand of the surgeon is passed transversely inwards in front of the pylorus and above the stomach, along the gastrohepatic omentum. When the hand is well placed, the fingers are flexed and the hand and wrist bent over to the patient's left, with the result that the common duct is twisted up into the wound and can be readily incised.

The surgeon's left thumb is then placed upon the duodenum in the position indicated in the figure. As soon as the duct has been brought well forward, a stitch is taken in the longtudinal axis of the duct, and well towards the posterior part of it. The

needle penetrates the whole thickness of the duct wall at two or three points. The ends of this suture are then seized in a clip, traction upon which fixes the duct and aids the subsequent suturing. Behind the ducts two or three small swabs are packed to catch the bile which escapes, often in profuse quantity.



Fig. 259.—Rotation of the common duct. The stone is made to project on the outer side by the pressure of the fingers. No gall-bladder adhesions need be separated to allow of this being done.

When the surgeon's left hand is well fixed he can feel the stone or stones between his left fingers and thumb. The stone is forced prominently against the wall of the duct, and a free incision made over it. The edges of the duct are at once seized in fine vulsella and the stones removed. Digital exploration of the

duct is necessary here also; indeed, all the details of the operation in this respect are those already described.

As soon as the ducts are cleared, a drainage tube is passed upwards into the hepatic duct, fixed by a catgut stitch, and



Fig. 260.—Rotation of the common duct. A stitch is introduced in the manner indicated to fix the duct; an incision is then made in front of it, and the stone extracted. Two stitches may be introduced, one on each side of the incision; then upper and lower ends when tied across bring the edges of the opening together.

the opening in the common duct closed, by a continuous suture, snugly around the tube.

I believe that this method of rotation of the duct is of the greatest possible service in not a few cases. It has been my fortune to see recently seven cases in succession in which the gall-bladder was shrunken and buried in adhesions implicating the

duodenum, colon or omentum, and in all the method above described has been carried out successfully. If the adhesions, however dense, do not produce any interference with the proper action of the duodenum or pyloric end of the stomach, they need certainly not be interfered with; for if they are separated they are certain to re-form. Their separation then is time-consuming, a little hazardous, and futile. The futility is shewn by the fact that at secondary operations performed after gastrolysis alone has been thought necessary, the adhesions are always found as dense and as numerous as ever, although the immediate result of the first operation may have been striking. In expressing this opinion I find that I am not in agreement with Mr. Mayo Robson, who writes: "If adhesions have been thoroughly separated, as they always should be, the surgeon has immediately under his eye the whole length of the ducts with the head of the pancreas and the duodenum."

The after-results of my cases shew beyond disproof that separation of these adhesions is not necessary.

In all these remarks I refer of course only to cases in which the gall-bladder is shrivelled, contracted, and empty; when, in fact, it is a mere cicatrix. If it contains stones, or mud, or pus, it should be dealt with separately, and such stripping of adhesions done as is necessary.

I do not suggest this manœuvre as a routine procedure, but in the exceptional circumstances which have been mentioned it may be of paramount service.

Second, **Retroduodenal Choledochotomy (Haasler's Operation).**—The retroduodenal portion of the duct may be reached from behind by a procedure similar to that employed by Kocher in the "mobilising of the duodenum" as a preliminary to the performance of gastroduodenostomy. This method was suggested at the German Surgical Congress in 1898 by Haasler. It had been found necessary three times in eighteen operations for stone in the common duct. Oscar Bloch, of Copenhagen, and Berg, have described a similar operation to this. In

the very great majority of cases a stone which appears to be fixed in this portion of the duct can be moved upwards into the first portion. The operation to be now described is, therefore, very rarely necessary.

The common duct is exposed in the manner already described. The parietal peritoneum of the posterior abdominal wall is now



Fig. 261.—Choledochotomy. Access to the common duct in its retro-duodenal portion is obtained by this "mobilising" of the duodenum after the method of Kocher.

incised vertically, about one and one-half inches to the right of the duodenum. The fingers are introduced into this incision, and the peritoneum stripped up until the duodenum is reached. By dragging gently on the second part of the duodenum it can be turned over to the left, so that its posterior surface is visible. Wiart suggests making the peritoneal incision to the outer side of the hepatic flexure and stripping the colon with the duo-

denum, towards the duodenum. I cannot see any advantage in this. A stone seated in the second portion of the duct can now be felt, and the duct over it incised. This part of the duct is either covered by or lies in a groove within the pancreas. The gland must, therefore, be cut, or be separated by blunt dissection. In Haasler's three cases the former procedure was once necessary, the latter twice. Vautrin has suggested the division of the pancreas by means of the thermocautery. The pancreas surrounding the stone is probably atrophied or sclerosed by reason of the constant pressure of the gradually enlarging stone, and is therefore only recognisable as thick and tough fibrous tissue. After removal of the stone the duct is explored and sutured, and a gauze drain left in the posterior peritoneal wound. A sound healing of the duct without leakage is not likely to occur, the duct being here devoid of any peritoneal investment.

Third, **Duodeno-choledochotomy.**—Of this operation there are two varieties. In the first the duct itself in its second or third portions is opened; in the second the ampullary opening is enlarged by incision of its edges. If the duct itself is incised the operation is known as *transduodenal choledochostomy*, or *Kocher's operation;* if the ampulla is opened the operation is known as *duodeno-choledochotomy*, or *McBurney's operation*. The former will be described first.

A. *Transduodenal choledochostomy*, or *Kocher's operation.*—In order to get at a stone impacted in the second part of the duct from the front, it is necessary to divide both the anterior and posterior walls of the second part of the duodenum, and then to incise the pancreas which lies around the duct. This operation was first performed on June 4, 1894, by Kocher, and was described by him as "internal choledocho-duodenostomy."

When the calculus has been impacted in the duct at this part for any length of time, the pancreas which lies between the duct and the inner and posterior part of the duodenum has probably become somewhat atrophied by pressure, and sclerosed as a result of chronic inflammation. In my own cases it has been so

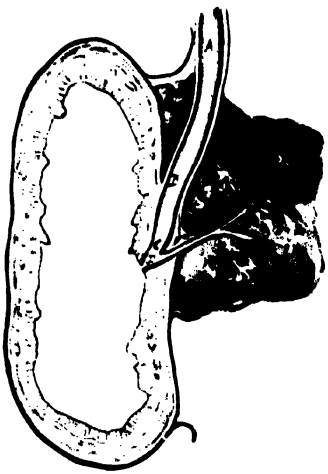


Fig. 262. — Section through the duodenum and the head of the pancreas to show the lower end of the common bile-duct. A to B in the second portion of the duct; B to C, the third portion; D, the ampulla.

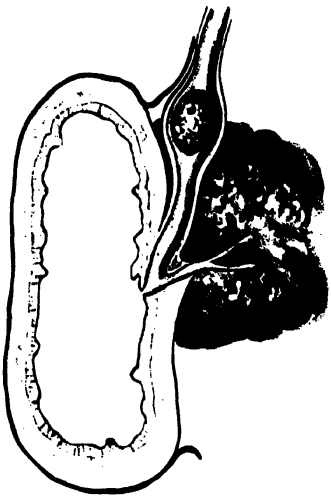


Fig. 263.—Shewing a stone impacted in the second portion of the duct. Note the compression of the pancreas between the duct and the duodenum. A stone such as this might be pushed upwards into the first part, removed by retroduodenal or by transduodenal choledochotomy.

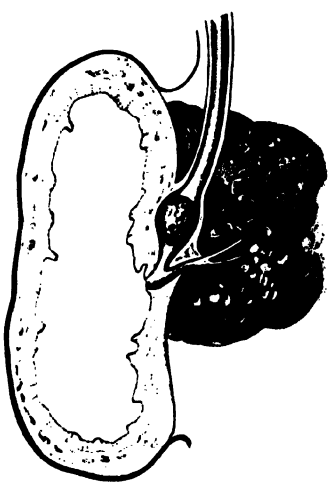


Fig. 264.—Stone impacted in the third portion of the common bile-duct. Such a stone would be removed by Kocher's operation.

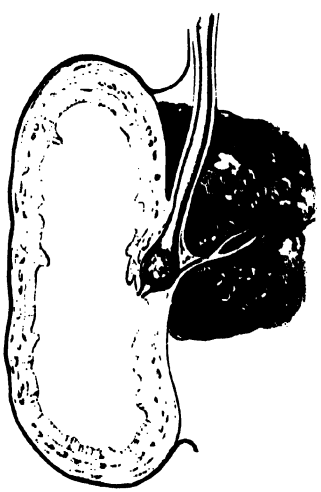


Fig. 265.—Stone impacted in the ampulla of Vater. This stone would be removed by McBurney's operation.

altered as to be barely recognisable as pancreatic tissue, though it was evident that the gland had been divided, because after incision of the posterior wall of the duodenum a very dense and thick fibrous layer was encountered before the duct was opened. The incision in the gland causes no ill effects.



Fig. 266.—Duodenocholedochotomy. Stone in the common duct low down. The duodenum has been freed and brought to the surface preparatory to being opened.

The preliminary steps of the operation are those necessary in all common duct cases.

As soon as the abdomen is opened a general examination of the parts is made and the procedure determined. Cholecystotomy or cholecystectomy may be necessary in addition to the removal of the stone by the method now to be described.

If the patient is thin, and if the liver lies low, the lifting and

rotation of the liver will generally leave a clear way to the duodenum, but in stout patients, with many adhesions, it may be a matter of no little difficulty to reach the bowel. The duodenum must then be rendered mobile by the procedure described by Kocher. A vertical incision is made about 1½ inches to the outer side of the duodenum, and the peritoneum stripped in-



Fig. 267.—Duodenocholedochotomy. The duodenum opened to shew the stone in the common duct above the ampulla.

wards to the duodenum from this point. When the intestine is reached the stripping is continued, the duodenum and the head of the pancreas being raised up towards the middle line. In this way it can be so secured that with a couple of fingers behind the duodenum, or in the foramen of Winslow, the bowel can be raised up to the abdominal wound. The fingers which so support the bowel must remain steady throughout the duodenal

manipulations, and must be protected from soiling by being covered by a flat gauze swab. When the duodenum is held secure, and the stone is localised, the anterior wall of the duodenum is incised and a small vulsellum placed on each edge of the wound. The fluids escaping from the duodenum are mopped up, and the posterior and inner wall of the bowel examined. The bulging

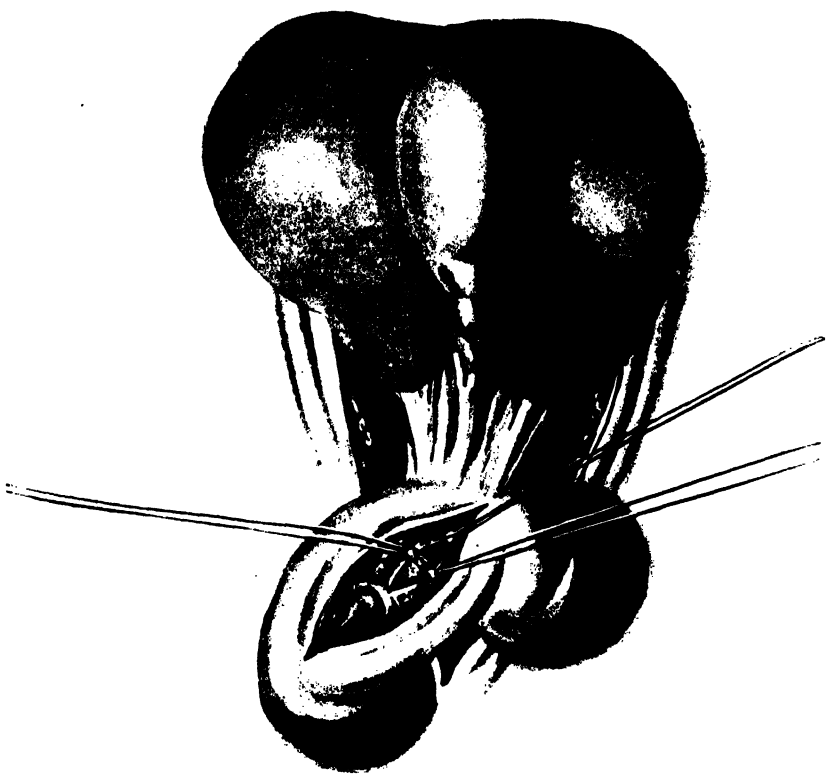


Fig. 268.—Transduodenal choledochostomy (Kocher's operation). Sutures in position; they are left long to act as retractors.

over the stone will then be readily discernible, and at a little distance below it the ampulla is seen. If the stone can be pushed downwards and extracted through the ampulla this should be done; but if not (and I have never been able so to do), then the duodenum is incised directly over the stone. The incision is carried at once down to the stone over a part of its projecting surface. Then a stitch is taken, on each side, through all the

tissues between the stone and the duodenal wall. These sutures are of catgut, and they are useful to steady the walls of the duct in the subsequent explorations. As soon as the sutures are tied (the ends are left long) the incision over the stone is lengthened to a degree sufficient to allow of the easy removal of the calculus. When the stone is taken away, a third stitch is taken

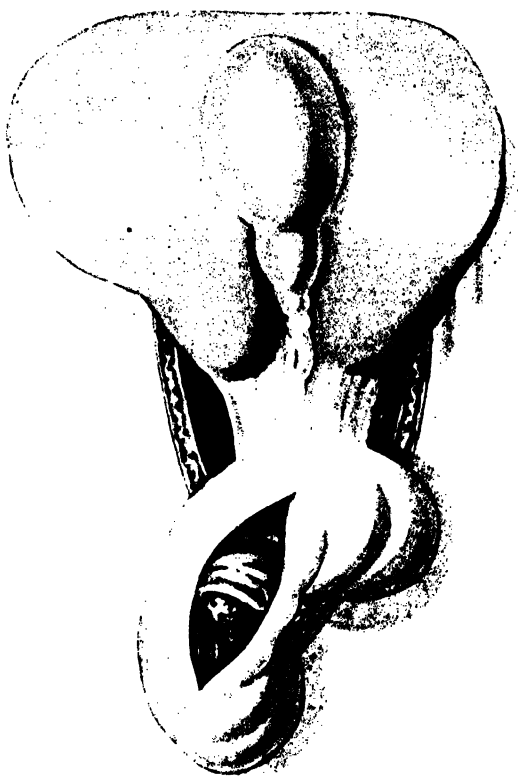


Fig. 269.—Duodenocholedochotomy (McBurney's operation). Stone in the ampulla. The edge of the ampulla is incised and the stone extracted.

at the extreme upper end of the incision. This also embraces the duct, the pancreas, and the duodenal wall. As soon as the stone is removed, bile begins to flow into the intestine, but other stones, may, nevertheless, be present in the ducts above. A scoop is therefore passed upwards as far as it will go (generally about 4½ inches, and the duct emptied. An examination with the finger, however, is a far more certain method of detecting

stones. A stone which is not felt when the scoop is passed is instantly recognised by the finger. When it is certain that no other stones remain the sutures (which have been useful as retractors) are cut short. It is not necessary always to introduce any other stitches, though Kocher advises that this should be done. If the second portion of the duct has been opened, leakage of bile through the wound is possible, though it is not likely on account of the fact that, owing to the large size of the stone, the duct has probably been brought into close contact with the wall of the intestine. If the opening is well above the papilla, sutures should therefore be introduced; if the opening implicates only the interstitial (third) portion of the duct, they are not needed. If they are considered necessary, they should be of catgut, and through-and-through sutures.

At this point there remains only the anterior incision in the duodenum to be closed. This is done in the usual manner, by two layers of stitches, the inner embracing all the coats of the gut, the outer only the serous and muscular coats. An omental flap may well be sutured over the duodenal incision also.

The fingers are now removed from behind the duodenum, and the bowel allowed to fall back into its natural position. If neither cholecystotomy nor cholecystectomy have to be performed, the abdomen may be closed without drainage. The advice is, I find, constantly given that a drainage tube should be passed down to the duodenum, but I have not found this necessary. The wound in the gut involves a surface clad with peritoneum, and healing therefore occurs quite securely.

If the third portion of the duct is involved the duodenum is of course not divided *completely through* on its inner and posterior part. This portion of the duct lies actually in the duodenal wall, and therefore, in order to open the lumen of the duct, the duodenum is cut *into*, and not *through*.

The following description of this operation is given by Kocher (Stiles' translation of fourth edition "Operative Surgery," p. 231). The operation is as follows:

The stone situated behind the duodenum is fixed with the finger, and after the duodenum has been opened, as above described, at a point opposite to the stone, an incision is made down on to the stone. Whether the incision should be transverse or longitudinal will be determined by the position and shape of the stone. The distended common bile-duct is more likely to be found applied to the duodenum in the whole length of the necessary incision, if the latter be made in the long axis of the stone. In this case also we advise, as does Elliot, for choledochotomy in general, that the wall of the duodenum and bile-duct right down to the stone should be seized with artery forceps as soon as incised, and, if necessary, a stitch may be passed through the middle of the entire thickness of both edges of the wound, so as to keep up the apposition of the two walls and facilitate a choledocho-duodenostomy, as we have termed the operation, if this be required. After the stone has been extracted the canal should be probed (with the finger if possible) so that other stones may not be overlooked. Whether the opening is now closed in the ideal way (by a suture through the whole thickness of the wound, with a secondary suture to approximate the mucous edges) or not must depend upon whether the opening in the papilla is stenosed or not. As a general rule, it will be found advantageous to make sure of a considerable opening where there is a danger of the formation of new stones. If the opening is not required, it will contract of its own accord. A suture should, therefore, be put in all round the opening through the whole thickness of both canals. In Kocher's and Kehr's case, in which this method was adopted, no bad consequences resulted from chance regurgitation of intestinal contents.

I have performed this operation in three cases, all successfully. The following are the notes:

CASE I.—Mr. N., aged fifty-six, sent by Dr. Bastow Cooper, Lincoln. The patient had had occasional attacks of severe pain in the right hypochondrium for four years; the attacks were accompanied by sickness. In February, 1905, a similar attack was followed by jaundice, which, set first very deep, gradually lessened until another attack of pain in April, 1905, after which it became very much deeper. Between April and September attacks of pain, followed by deepening jaundice, occurred about once a fortnight. In between these attacks the jaundice never lessened and no bile ever passed into the intestine. He was more deeply jaundiced than any patient I have ever seen. In the attacks he had shivering and nausea; each attack lasted from half an hour to two days.

A diagnosis of stone in the common duct was made and operation was performed on September 28, 1905. The abdomen was opened through Mayo Robson's incision. The gall-bladder was found shrunken and empty and adherent to the duodenum. A stone was felt in the second portion of the common duct just below the upper margin of the duodenum. A prolonged attempt to push the stone upwards into the supraduodenal portion of the duct was unsuccessful. The duodenum was therefore held secure in the fingers of the left hand, and its anterior wall opened by a longitudinal incision. The duodenal edges were seized in small vulsella, and an inspection of the duodenum made from within. A bulging of the inner and posterior wall of the gut was seen, and behind this lay the stone, fully an inch and a half above the ampulla of Vater. Incision was made over the stone. The stone even when well exposed was extracted with some difficulty; it seemed to have grown into the wall of the duct, and its outer surface was roughy and "spiky." After the stone was removed the duct was explored with the finger and with a scoop, but no other calculi were felt. No stitches were introduced into the posterior duodenal wound. The anterior wound was sutured and the abdomen closed. The patient recovered rapidly. By January, 1906, he had gained 1½ st. in weight, and was perfectly well.

CASE 2.—Mr. J. V., aged fifty-two, sent by Dr. Lambert, Farsley. The patient had noticed a dull aching pain in the gall-bladder region five months ago; this lasted ten days and was followed by jaundice, which has never cleared off since. He has had attacks of pain, shivering, nausea, followed by deepening jaundice ever since. The jaundice almost disappears between the attacks. A stone in the common duct was diagnosed and operation performed on November 3, 1905. The abdomen was opened through Mayo Robson's incision. The gall-bladder was shrivelled and buried in a mass of dense fibrous tissue. A stone was felt in the retroduodenal part of the duct; it was fixed. The duodenum was therefore opened, and about one inch above the papilla the bulging of the stone on the posterior and inner wall was seen. An incision was made down to the stone, which was readily extracted. No sutures were introduced in this incision. The duodenum was closed, and as there had been some soiling of the parts a drainage tube with a gauze wick was left in for five days. The wound was slow to heal, but in five weeks was perfectly sound. The patient was seen on February 28, 1905. He had gained 2 st. 2 pounds and reported himself as "quite right."

CASE 3.—Mrs. B., aged fifty-six, sent by Dr. Hutton. The patient has suffered for many years from indigestion, "spasms," flatulent distension of stomach, but has never been jaundiced. The present illness dates back three months, when she was taken ill with shivering, vomiting, and dull abdominal pain, followed by jaundice. Since then similar attacks have occurred at intervals of about a fortnight. The jaundice becomes slightly less in the intervals, but by no means disappears. The pain, which is not severe, is felt down the right side of the abdomen and up to the scapula. The stools are light coloured. On examination, February 24, 1905, a stout woman with marked jaundice. Liver edge felt in the gall-bladder region which is tender. Operation February 25th. Mayo Robson's incision. Duodenum firmly adherent to gall-bladder, which was almost hidden among dense adhesions. By invaginating the duodenum with the finger the crateriform hollow of a deep ulcer could be felt where the gut was welded to the gall-bladder. A calculus was felt in the hepatic duct and pushed down into the common duct. A stone was also felt impacted and im-

movable in the common duct, just above the ampulla. The duodenum was opened and its posterior wall incised over the stone, which was extracted. Three more stones were then taken from the common duct and finally a probe passed up for 5 inches into the hepatic duct. The anterior wall of the duodenum was closed with a continuous suture, in two layers. A covering of omentum was fixed over the suture line by two interrupted sutures. Abdomen closed without drainage.

B. *Duodeno-choledochotomy—McBurney's operation* (ampullary choledochotomy).—In cases where this operation is performed the stone is arrested in the diverticulum of Vater, having passed down the whole length of the common duct. The stone is usually small, about the size of a split pea. The operation in all its details is similar to that which has just been described except that the incision in the anterior wall of the duodenum is made a little lower down. As soon as the duodenum is opened the stone may be seen protruding through the ampulla, and a little frothy bile-stained fluid may escape past it. In McBurney's first case an attempt was made to extract the stone by dilating the orifice of the ampulla, but this was not successful. The edges of the opening were therefore incised and the stone extracted.

As soon as the stone has been removed, small vulsella should be placed on the lateral edges of the opening, and a gall-stone scoop passed upwards into the common duct. The duct is always dilated, and some fine stones or sand may be removed. In some cases an opening may have already been made in the supraduodenal part of the duct for the purpose of extracting a stone impacted there, the later opening of the duodenum being necessary because of the impossibility of displacing the ampullary stone upwards. If this has been the case, it is well to pass in through the supraduodenal opening a wick of gauze which is brought out at the ampulla. On pulling a long strand of this through the duct, some fine sand, or grit, or small stones may be removed.

In both this operation and in Kocher's operation a longitudinal incision is made into the duodenum through the serous-

covered anterior surface. Such a wound, when carefully sutured, heals well. Several operators record cases of duodenal fistulæ following these operations, and I think it not improbable that this has been due to drainage of the wound. The drainage material has adhered to the suture line, and has, when removed, torn open the wound. I have never drained down to the duodenum in any of my cases, but have always sutured carefully, and have made assurance doubly sure by laying over the line of stitches a flap of omentum.

The following are brief notes of the cases upon which I have operated—seven in number. The first patient died; all the remainder recovered.

CASE 1.—Mrs. T. B., aged thirty-nine, seen with Dr. Sproulle, Mirfield. Three years ago she had an attack of epigastric pain and vomiting, followed by slight jaundice, a typical attack of biliary colic. Since then she has had nine similar but progressively more severe attacks; nine weeks ago an extremely severe attack. Pain has continued all the time, and jaundice, though varying slightly, has always been pronounced. The motions during this period have been light coloured, the urine thick and scanty. Pain is constant, but at times an acute paroxysm occurs. Has lost flesh rapidly during the last two months, and has been eating little, owing to pain and heaviness after even light diet, and vomiting. Operation December 7, 1900. Eighty-seven gall-stones were removed, mostly from the hepatic and common ducts. A few lay in the gall-bladder, but both hepatic ducts and the whole length of the common duct were filled with tightly packed stones. These were removed through an incision in the common duct, which was afterwards sewn up. A stone was found tightly impacted in the ampulla of Vater, and the duodenum had to be opened in order to remove it. The patient had severe hæmatemesis after the operation and died on the third day.

CASE 2.—Mrs. M. A. R., aged forty-one. Calculus in the ampulla of Vater; chronic pancreatitis; duodeno-choledochotomy. The patient was admitted on March 23, 1901. The history was that attacks of pain in the right hypochondriac region had been intermittently present for eight or nine years. Sixteen months before admission jaundice was noticed for the first time. Similar attacks of pain, followed by jaundice, had been noticed several times since that date. On admission she was jaundiced and the colour had been present, though varying in tinge, for four months. A stone in the common duct was diagnosed. The abdomen was opened and a stone was found impacted in the ampulla of Vater. The head of the pancreas was densely hard,—as hard as stone. I remarked at the time that the gland felt more like a plaster cast of a large pancreas than like a normal organ. The duodenum was incised and the stone was removed. The gall-bladder was drained for eleven days. The patient made a good recovery and is now quite well (March, 1906).

CASE 3.—Mr. J. A. E., September 24, 1902. For the last four and a half years has suffered from acute pains in the right hypochondrium. After an attack of the normal kind he became jaundiced nine weeks ago, and since then has remained jaundiced more or less. For the first month the jaundice steadily deepened; then a rigor occurred and the jaundice became still more intense, but quickly got less. Now jaundice is not more than sallowness. Has had three rigors recently with slight increase in jaundice after each attack. At the operation, a small stone in the ampulla of Vater, and a few gritty particles in the gall-bladder. The duodenum was opened and the stone removed from the gall-bladder. Cholecystotomy was performed. The patient recovered; in March, 1906, reported as having been quite well since the operation.

CASE 4.—Mrs. A. D., aged thirty-nine, sent by Dr. Handcock, Scarborough, July 11, 1903. Seven months ago patient began to suffer from pain in the right hypochondrium; collapse, faintness and vomiting. The first attack was followed at once by jaundice. Between this and five weeks ago, after a similar attack, a stone was passed and was recovered from the fæces; but since then jaundice has been continuously present, though variable in depth of tinge. Every few days, lately, has had attacks of shivering and slight pain. Operation was performed after a diagnosis of stone in the common duct had been made. A stone the size of a split pea was removed from the ampulla through the duodenum. The gall-bladder contained stones (forty-eight were subsequently counted); it was therefore aspirated, and clear mucous fluid removed. A few small stones were immovably fixed in the cystic duct. The gall-bladder was removed and a drainage tube introduced into the junction of the hepatic and common ducts. Recovery was uneventful; quite well in March, 1906.

CASE 5.—Mr. G. K., aged fifty-three, sent by Dr. La Touche, Ossett, July 25, 1903. Cholecystectomy; duodeno-choledochotomy. The patient had suffered for a "great many" years from pain after food,—nausea, belching, distension of stomach. Four months ago, after a severe attack of pain, became jaundiced and has remained so since then. There have been many attacks of pain, nausea, and shivering, followed by deepening jaundice. There has been a loss of over two stones in weight. Stone in the common duct was diagnosed. At the operation a hard, shrivelled gall-bladder, with a few stones in its contracted cavity, was felt, and a single pea-like stone in the ampulla. The duodenum was opened, the ampulla exposed, and a small stone seen to be projecting through its orifice. The opening was enlarged slightly and the stone removed. A scoop passed up the duct discovered no other stone. The gall-bladder was then removed, as the cystic duct was found blocked, and a drainage tube passed into the hepatic duct. The patient recovered, and remains well to-day, having gained over two stones in weight (March, 1906).

CASE 6.—Mr. T. H., aged forty-two, April 25, 1904. Cholecystotomy; duodeno-choledochotomy. The patient has suffered for years from "chronic dyspepsia." Three years ago he had an attack of very severe pain, followed by jaundice. Five months ago a similar attack, and since then has never been free from jaundice. Has had attacks of very slight pain, and slight deepening of the jaundice, but his colour has never been more than "sallow." At the operation a gall-bladder with thickened walls was found to be full of stones. The common duct was very much dilated, and a stone the size of a small Barce-

lona-nut was felt in the lower part of the duct. The duodenum was opened to remove this, and the stone was seen through the orifice of the duct (I doubt if the ordinary form of "ampulla" was present). The opening was enlarged and the stone removed. The gall-bladder was then opened, many stones removed, and a drainage tube placed in it. Quite well in February, 1906.

CASE 7.—Mrs. M. N., aged thirty-six, January 26, 1906, sent by Dr. Cass, Ravenglass. For two years the patient had suffered from gall-stones; there were attacks of pain in the right hypochondrium, followed by jaundice. In August last, a very severe attack with a rigor and jaundice. Since then has been continuously jaundiced, though at times, if free from pain, the jaundice has almost gone, and the urine and fæces have been normal. Her last attack was on December 26, 1905. When seen on January 26, 1906, was very slightly sallow. Operation January 31st. The abdomen was opened through the right linea semilunaris. A stone was felt at once in the ampulla. The duodenum was opened by a longitudinal incision and the calculus extracted. The gall-bladder was contracted and thickened; it contained four stones. Cholecystectomy was performed.

The following description of his first case is given by McBurney ("Annals of Surgery," vol. xxviii, p. 483):

"On opening the abdomen I found a much enlarged and engorged liver; an atrophied gall-bladder containing no calculi; moderate adhesions covering the cystic and common duct, which were, however, easily broken down, allowing of complete palpation of the entire bile track. With one finger behind the duodenum and another depressing its anterior surface a large, hard mass was readily discovered lying behind the centre of the descending portion of the duodenum. This was clearly a calculus. I at first made a somewhat prolonged effort to so raise the duodenum and bring the lower end of the common duct into view as to enable me to open the latter and extract the stone. I found that this was quite impossible, for I could neither bring the lower end of the common duct into view, nor, if I opened it, could I expect to be able to suture it. It occurred to me that if I entered the duodenum through the anterior wall of its descending portion I should come at once to the point where the duct joined the intestine. I therefore made a vertical incision, about 1½ inches long, at the point referred to, and found the papilla which marked the entrance of the common duct, directly opposite the incision. A probe was introduced without difficulty, which, after passing about half an inch upward through the duct, came in contact with a firmly impacted stone. The orifice of the duct

was first slightly incised, then with the aid of forceps largely stretched, until it was possible without difficulty to dislodge the calculus and draw it down into the intestine. Large quantities of bile immediately flowed into the gut. The wound in the intestine was then sutured with three rows of silk. The parts that had been exposed were carefully cleansed and the abdominal wound sutured with catgut, leaving only a small orifice for drainage by means of a piece of iodoform gauze. The drainage material was removed at the end of two days, and, although the superficial wound was somewhat slow in healing, the patient made a complete recovery without fever or other abnormal sign of any kind. Her weight, which had been reduced to 90 pounds within six months, has returned to her normal standard of 180. Since that time I have frequently seen this patient, and she has remained in robust health up to the present date."

Difficulties experienced during the performance of Choledochotomy. -During the performance of operations for gall-stones it may be difficult it is, indeed, at times impossible—to say whether a stone is present in the common duct. An enlarged lymphatic gland lying in the free edge of the gastrohepatic omentum may be absolutely indistinguishable, by touch alone, from a calculus in the first portion of the common duct. It causes a hard, rounded, slightly mobile swelling, in all respects similar to a stone. When, however, the method of rotation of the liver is employed and the duct is brought to the surface, the distinction between the two is readily made.

It is not so much in this first part of the duct that difficulties are likely to occur: it is in the second and third portions of the duct; when a stone is present, it may be, indeed often is, surrounded by a dense thickening in the head of the pancreas, so that in the midst of this tough mass no definite stone can be felt. Or, on the other hand, so dense and resistant a swelling may there be felt that the surgeon has no doubt that a stone will be found. Yet, on cutting into the swelling, or on introducing a finger into the duct, no calculus may be felt. In some instances a small chronic abscess in the head of the pancreas may be opened.

Legueu, Schwartz, and others have recorded cases of localised induration of the head of the pancreas, incised in the belief that a stone was present, and until I became familiar with the conditions of chronic pancreatitis I made several such mistakes.

When a stone is impacted in the ampulla of Vater, it may be so small as to be felt with difficulty, or, being felt, it may be mistaken for a hard, inflammatory, or perhaps malignant nodule in the pancreas. A growth in the ampulla cannot be discriminated from stone until the duodenum is opened. In the only case of carcinoma of the ampulla that I have seen it was thought that the small, hard, rounded lump was calculous, and it was only after exposing the ampulla that a growth therein was disclosed. Difficulties, therefore, in the recognition and discrimination of stone in the lower end of the duct may arise from—(*a*) Stones being overlooked, a thickening felt upon the duct, and its surroundings being looked upon as due to inflammatory deposit; (*b*) no abnormality being recognised when a postmortem examination or a later operation discloses the presence of a stone; (*c*) a condition supposedly due to calculus being recognised and the duct being directly incised, or the ampulla laid open and the duct probed, with the result that no obstruction is found.

LUMBAR CHOLEDOCHOTOMY.

Access to the common duct may also be obtained by the lumbar route, as was shewn by Braun in 1876. On one occasion Tuffier has performed lumbar choledochotomy successfully. The method, however, as a deliberate procedure, possesses no conceivable advantages, and may usefully be relegated to oblivion.

Though these operations are described separately for convenience, it must not be considered that they are performed in the academic method here portrayed. In several instances I have simultaneously performed choledochotomy and cholecystotomy, choledochotomy and cholecystectomy, and duodenocholedochotomy and cholecystotomy or cholecystectomy. One

point cannot be too frequently nor too strenuously emphasised —that is, that drainage is the secret of success in gall-bladder surgery; it is always an advantage, often imperative. In cases of cholangitis, as made manifest by fever or jaundice or both, and of pancreatitis, drainage must be practised, and should be maintained for a considerable time.

OPERATIONS FOR IMPERMEABLE OR IRREMOVABLE OBSTRUCTION OF THE COMMON DUCT.

When the common duct is occluded by stricture or growth, or rarely by inaccessible or irremovable calculus (if, indeed, such a thing exists), it may be necessary to divert the stream of bile by forming a communication between the gall-bladder or the duct above the obstruction and some part of the alimentary canal. Anastomoses have been made between the gall-bladder and the stomach—cholecystgastrostomy; with the duodenum or any part of the small intestine cholecystenterostomy; or with the colon—cholecystcolostomy. The common duct has been united to the duodenum or other accessible part of the small intestine—choledocho-enterostomy. The duodenum is the portion of the bowel selected whenever possible, but where adhesions are binding and inseparable, any accessible portion of the stomach or small or large intestine may be chosen. These operations are rarely practised at the present time. Since the longer incisions have been made, and the method of rotation of the liver already described has been practised, the common duct has been more readily accessible, and any obstruction has been more easily overcome. There are very few indications for the operations.

CHOLECYSTENTEROSTOMY.

The operation of cholecystenterostomy was suggested by Nussbaum and first performed by von Winiwarter in an operation which was completed in six stages on dates from July 20, 1880, to November 14, 1881.

It has been generally agreed that for the purpose of effecting the anastomosis a Murphy button should be used, and if any mechanical appliance is necessary, certainly none is so good as this.

In one case, however, Mayo Robson has found the anastomotic opening made in this way narrowed almost to obliteration. I have only three times been called upon to perform the operation—in cases of chronic pancreatitis. I then adopted the method of simple suture, the stitches being passed in exactly the same manner as in the operation of gastro-enterostomy. The advantage of simple suture is that the opening may be made of ample size, so that subsequent narrowing or closure need not be feared.

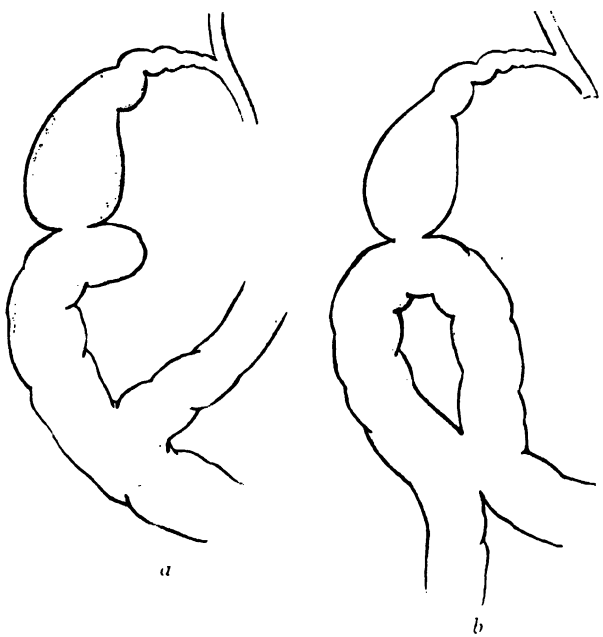


Fig. 270.—*a*, Cholecystenterostomy combined with exclusion of the intestine and end-to-end anastomosis: a method I have adopted once; *b*, cholecystenterostomy combined with entero-anastomosis as suggested by von Mikulicz and Maragliano.

If possible, enough of the gall-bladder and of the duodenum should be drawn up into the wound to allow of the application of small curved intestinal clamps. These will facilitate the operation considerably by keeping the viscera to be sutured close together without difficulty, and by preventing any leakage from the openings. The two portions to be anastomosed lying side by side, a continuous suture of fine Pagenstecher thread is now in-

troduced along a line at least one inch in length. This suture picks up only the peritoneal and subperitoneal coats. In front of this line of stitches an incision is now made into the gall-bladder and into the intestine, the length being about three-fourths of an inch. The edges of these incisions are now united by a continuous suture of catgut which begins at the one end of the incision, unites the posterior edges of the wounds until the opposite end is reached, and then returns along the anterior edges until the starting-point is reached. The suture is a continuous one, and unites the edges by a through-and-through stitch. The edges of this suture are cut short, and the first needle which has been temporarily laid aside is now resumed and the serous coat united along the anterior margin of the wound, to the point whence it started. Thus there are two continuous sutures which completely surround the opening: an inner one of catgut, which picks up all the coats of each viscus, and an outer one of Pagenstecher thread, which unites only the serous and subserous coats.

If the duodenum is not accessible, the stomach may be chosen. The records of seven cases of cholecystgastrostomy were collected by Perier in 1902. Of these, six proved successful. The fact that bile is not injurious to the stomach and does not in any way interfere with digestion has been shewn by a case of my own recorded in the "British Medical Journal," vol. i, 1901, p. 1136, and by the experiments of Stendel upon dogs.

If the small intestine is selected for the anastomosis, some difficulty may result from the passage of the intestinal contents into the gall-bladder. To overcome this difficulty the operation may be performed after the method suggested by Mikulicz. A loop of the intestine is isolated. The apex of the loop is united to the gall-bladder; the sides of the loop, about four inches away, are united to each other by a lateral anastomosis. The intestinal contents are in this way short-circuited, and there is no risk of infection of the gall-bladder from the intestine.

It would, doubtless, be an advantage in cases such as this

to perform intestinal exclusion as well as cholecystenterostomy. The small intestine at the point selected would then be divided completely; the proximal end would be united to the side of the distal end, about five inches from the point of division, and the distal end would be closed, or a lateral anastomosis made with the fundus of the gall-bladder.

CHOLEDOCHOSTOMY.

The operation of choledochostomy, the opening of the common duct and the suture of the margins of the openings to the abdominal wound, is said to have been first performed by Parkes. This, however, is incorrect. It was drainage of the duct that Parkes adopted —the performance of choledochotomy without sutures. The operation of choledochostomy was first performed by Helferich in 1887, subsequently by Ahlfeld, von Winiwarter, and others. The nature of the operation in the cases of Helferich and Ahlfeld was recognised only at autopsy; it was believed in both that the distended gall-bladder was being opened. To von Winiwarter belongs the credit of first deliberately performing the operation, knowing what he did. In all the cases recorded the common duct has been greatly, often enormously, dilated behind an obstructing calculus. That the dilatation must be considerable is recognised when we know that in two cases mentioned, and in several others, the duct has been mistaken for the gall-bladder, or even for a pancreatic cyst. Several remarkable examples of extreme dilatation of the common duct have

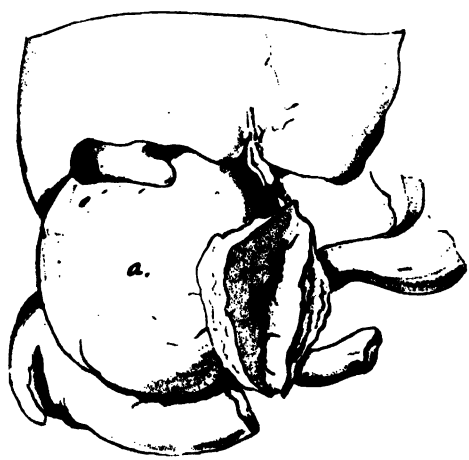


Fig. 271.— Ahlfeld's case of choledochostomy: *a*, The dilated duct stitched to the skin.

already been mentioned. The duct may be opened, emptied, and forthwith stitched to the parietal peritoneum and the aponeurosis, or the operation may be done in two stages, the opening of the cyst being deferred until union between the duct and the peritoneum is complete.

In Helferich's case the biliary fistula bled and suppurated, and the patient died about one month after the operation. Ahlfeld's patient died on the eighth day, of collapse. Von Winiwarter's patient died six weeks after the operation, of gradual exhaustion due to the generalisation of a malignant growth. The following case is worthy of record as shewing the conditions likely to be met with during operation. It is recorded by Hamilton Russell ("Annals of Surgery," vol. xxvi, 1897, p. 692):

"George S., aged eight, was admitted to the Melbourne Hospital for Sick Children March 23, 1897. On the eighteenth, five days previously, he became feverish and ill, and on the next day, the nineteenth, the mother noticed a swelling of the right side of the abdomen. There was constipation, and the one motion passed during the five days prior to admission was putty-like and offensive; the urine was deeply coloured with bile.

"On admission the patient was a well-nourished child, with the history of having enjoyed excellent health up to the onset of the present illness. Jaundice was general and marked; temperature, 102° F.; pulse, 128. The right flank was occupied by a large, tense, elastic tumour, dull on percussion, being continuous with the liver-dulness above; extending downwards an inch below the iliac crest, reaching inwards nearly to the middline, and posteriorly occupying the entire lumbar region. There appeared to be distinct tenderness on palpation of the tumour; there was a slight increase of the liver-dulness upwards. A second, smaller tumour projected visibly immediately beneath the rib-cartilage about the right linea semilunaris; this tumour was rather larger than a pigeon's egg, round, soft, elastic, and painless. Both heart and lung sounds were normal.

"The view taken as to the nature of the case was as follows: The larger tumour was believed to be an echinococcus cyst, which had escaped notice until the onset of the present illness;

the smaller tumour was either a second cyst or possibly a distended gall-bladder.

"Operation on April 8. The abdomen was opened by a four-inch incision in the right linea semilunaris, extending downwards from near the costal margin. The smaller tumour at once presented, and was found to be the gall-bladder distended with colourless contents; there were no adhesions, so that its entire contour could be readily felt. Turning now to the larger cyst, this was found to be retroperitoneal, and the colon was bound to the face of it, being nearer the inner than the outer side of the cyst. An exploring syringe was now used, and perfectly clear, limpid fluid obtained, having all the physical appearance of hydatid fluid. The cyst was next emptied in great part by aspiration and then incised, when three surprising discoveries were made: (1) in the fluid, as it flowed, there came several blackish masses looking like cinders; (2) there was no echinococcus cyst; (3) at the end of the flow the fluid was observed to suddenly change in character, and in place of the clear, limpid fluid there came one or two ounces of less clear and distinctly mucinous fluid. It was now ascertained that this mucinous fluid had come from the gall-bladder, which was collapsed, having emptied into the larger cyst. Thus it was evident that this large retroperitoneal cyst had a communication with the common bile-duct, and the only conclusion I was able to arrive at as the result of much speculation, with which I need not weary the reader, ascribed to the cyst a pancreatic origin; the possibility did not occur to me that in a child of eight, who had never suffered a day's illness until three weeks previously, this enormous cyst could itself be the dilated common bile-duct.

"The operation was completed by stitching the opening in the cyst to the musculature of the abdominal wall, and closing the abdominal wound. After the operation the whole of the bile commenced to flow from the opening; with the view of ascertaining whether there was any admixture of pancreatic fluid with the bile, its digestive properties were investigated by my colleague, Dr. Stawell, with a negative result, nor was any excess of fat discovered in the stools. The child died four days after operation from hæmorrhage, the result of uncontrollable oozing from the stitches and into the cyst.

"*Autopsy.*—The body was universally jaundiced, and had

the waxen appearance characteristic of death from hæmorrhage; the cyst was filled by a mass of normally clotted blood, with some bile. On opening the body the intestines appeared to be lightly smeared with blood, and the points of contact of neighbouring coils were marked by lines of blood; all the organs were healthy with the exception of those concerned in the operation. The liver, with the system of biliary vessels, including the cyst, the duodenum, pancreas, and spleen, were removed in one piece. The cyst is seen to communicate anteriorly with the gall-bladder, the cystic duct being dilated so as easily to admit an ordinary pen-holder. At the transverse fissure the dilated hepatic ducts are seen opening into the cyst. The duodenum and the head of the pancreas are spread over the outside of the cyst. A careful search for the terminal portion of the common bile-duct reveals a small valvular opening on the interior of the cyst, through which a probe can be passed into the duodenum, on the surface of which it appears through the usual papilla; that this is the normal termination of the common bile-duct is proved by passing a second probe through the same duodenal orifice into the pancreatic duct; this can be easily done. Russell adds: 'We may safely conclude that the condition was congenital.' "

Additional cases are recorded by Edgeworth and others.

CHOLEDOCHO-ENTEROSTOMY (RIEDEL'S OPERATION).

If the nature of the cyst formed by the dilatation of the common duct can be recognised, it is certainly better to perform an anastomosis between the overdilated duct and the intestine. This operation, choledocho-enterostomy, was first performed by Riedel in 1888. It was Riedel's intention at first to cut across the duct completely and to implant the severed end in the duodenum, but, abandoning this idea, he united, by lateral anastomosis, the dilated duct to the bowel. The patient died as a result of the leakage of infected bile into the general peritoneal cavity. Kocher, in 1890, operated upon a patient in whose common duct two stones were impacted. The duct behind the block was greatly dilated, and it was his intention to unite the duct to the duodenum lying in contact with it, and sutures were

introduced for the purpose. The obstruction of the duct, however, was relieved by the breaking-up of the stones, and the opening, therefore, was not made. Sprengel, in 1891, reported the first recovery after this operation, the patient being a woman upon whom he had previously performed cholecystectomy. During the first operation the greatly dilated duct was mistaken for the duodenum, and a calculus felt therein was pushed onwards.

Several operations have been done under the impression that a cholecystenterostomy was being performed—the exact conditions being made clear only at an autopsy.

The anastomosis has been effected either by simple suture or by the aid of mechanical appliances, such as Murphy's button, as in Czerny's case, or Boari's button. The method of lateral approximation has been always adopted.

The following case is related by Swain ("Lancet," vol. i, 1895, p. 743):

"On October 12, 1904, I was asked by Dr. Clay to see a girl, aged seventeen years, who had been brought to him for the first time on the preceding day. She had been ailing more or less for two years. In January, 1894, she became jaundiced, and a swelling formed under the liver. She had been treated by two medical men with mercury and other drugs, but in spite of their treatment the jaundice deepened and the swelling under the liver increased in size. They appear then to have told the parents that nothing more could be done, whereupon Dr. Clay was consulted. The condition of the patient when I saw her was briefly as follows: She was very deeply jaundiced; the urine was the colour of porter. The stools were white. She suffered no particular pain, had not been sick, and throughout her illness neither of these symptoms had been present. She was much emaciated. There was a large abdominal tumour reaching from below the liver to the brim of the pelvis and across the abdomen obliquely about 3 inches to the left of the umbilicus. The whole swelling was absolutely dull on percussion, and the merest tap on any part of it produced a thrill of fluctuation. Taking the sum of her symptoms we had little doubt that it was distended gall-bladder, although the possibility of a hydatid cyst

was suggested. I aspirated the tumour with a full-sized aspirating needle, and we immediately perceived the characteristic fluid of distended gall-bladder. As if to make assurance doubly sure, towards the latter end of the aspiration a gall-stone struck the cannula repeatedly, and the click of impact was heard by Dr. Clay, the father, and myself. The quantity of fluid withdrawn was six pints and one ounce. No evil results followed the aspiration, and I did not see the patient again until October 17, when I found that the swelling was as large as ever. We then advised that an operation should be performed, and for this purpose she was removed to the private home for patients, and on the following day I operated on her. An incision about four inches long was made a little to the outer side of the right linea semilunaris. The integuments were very thinly spread over the tumour, and the peritoneum was rapidly reached and opened. The cyst, being exposed, and packed well round with small sponges, was tapped with an aspirating needle. Fluid of the same character as before was withdrawn, but to the amount of seven pints and twelve ounces. On passing the hand into the abdominal cavity the cyst was found to be firmly adherent to the intestine in all directions, the transverse colon being spread out over it. A small opening was now made, sufficiently large to admit the forefinger. The cyst-wall was very thin, but tough. Externally, it was of a dark chocolate colour; the cut edge was rather white, and the interior bile-stained. On introducing the forefinger after a prolonged search no gall-stone could be found, although, as previously stated, the presence of one could not be doubted. The finger passed upwards and inwards towards the liver into a passage with a crescentic opening, which I believed to be the common bile-duct; but a probe passed down far beyond the finger impinged on no stone. Up to this time I had no doubt but that I was dealing with a huge, dilated gall-bladder, but my astonishment may be appreciated when I found, in the course of further investigation as to the relations of the parts outside the cyst, the gall-bladder in its normal position, somewhat pale in colour, undistended by bile, and containing no gall-stones. The question now arose as to what course was the best to pursue. To remove the cyst was impossible. To stitch it to the parietes seemed to condemn the patient to a perpetual fistula, or, at any rate, to very prolonged drainage. I decided, therefore, to accept

the other alternative and to attach the cyst to the intestine. Without much trouble I succeeded in drawing up a good coil of jejunum close to the duodenum. My great difficulty was to get a good surface on the cyst. In order to do this I had to tear through the two layers of the mesocolon, and even then the surface obtained was limited. The cyst was then rapidly attached to the bowel by Murphy's button in the manner described by him. The small original opening made to explore the cyst was closed with Lembert's sutures. The peritoneal cavity, which had been thoroughly well packed with sponges, was now cleansed, and the pouch to the outer side and beneath the liver drained with a Keith's tube. The wound was closed with silkworm-gut sutures."

A case is recorded by Terrier in which, after the anastomosis of a dilated duct to the upper part of the duodenum, the bile flowed backwards into the stomach and was vomited in large quantities.

A case of choledocho-enterostomy is also recorded by Brenner ("Virchow's Archiv," November, 1899, vol. clviii, part ii).

In certain cases there may be an actual loss of substance as a result of operations on the common duct. An anastomosis then between the common hepatic duct or the upper end of the common bile-duct, on the one hand, and the duodenum on the other, may be necessary.

Dr. W. J. Mayo reports ("Annals of Surgery," August, 1905, p. 90) a case of choledochotomy and cholecystectomy followed by stricture of the common duct. A secondary anastomosis was effected twelve months later between the hepatic duct and the duodenum. The following is his description of the operation and the annexed figures are copied from his:

"A five-inch incision was made just internal to and parallel with the cicatrix of the former wound. A dense tangle of adhesions was encountered, involving transverse colon, duodenum, and stomach, on the one side, and the liver and ducts on the other. By following the remains of the fistulous tract carefully and keeping close to the liver the original drainage opening at the

site of the cystic duct was discovered. The hepatic duct was dilated and easily admitted the tip of the index-finger to the primary division. The common duct was reduced by cicatricial contraction to a fibrous cord, along which could be traced a little stain of bile. During the separation of adhesions it was noted that the duodenum overlapped the remains of the common duct and formed one wall of the fistulous tract in its deeper portion. The external incision was continued to the sternal notch and the



Fig. 272.—Hepatico-duodenostomy (Mayo's method).

overlying liver held upwards. The duodenum was still further mobilised. The hepatic duct was freed from its attachment to the fistulous tract and from the remains of the common duct; the adhesions posteriorly were not otherwise disturbed, and served a very useful purpose. About three inches from the pylorus the duodenum was caught with three catgut sutures and fastened firmly to the adhesions and scar tissue about the hepatic duct, so that it was brought into contact with the end of the piece of all the coats of the hepatic duct. At the point of easy contact, an elliptical piece of all the coats of the duodenum was excised of



Fig. 273.—Hepatico-duodenostomy (Mayo's method).



Fig. 274.—Hepatico-duodenostomy (Mayo's method).

about the same diameter as the open end of the hepatic duct, and four or five catgut sutures were introduced from the mucous side through all the coats of both duct and intestinal wall. In this way the posterior line of the anastomosis was completed. By alternately placing a suture externally and internally the sides were built up in a similar manner to a two-row intestinal anastomosis, excepting that only the inner row penetrated the duct-wall. At the upper part the few remaining sutures were all placed before they were tied. The duodenum was still further attached laterally and anteriorly to the scar tissue, covering the liver and ducts by catgut sutures, making a broad area of attachment. A drain of rolled gutta-percha tissue was placed at the upper angle of the abdominal incision and another at the lower, but each at a considerable distance from the anastomotic suture line. The abdominal incision was then closed. Time of operation, fifty minutes. Patient made an uninterrupted recovery. There was no leakage of any kind; drains were removed on the sixth day; patient discharged on the sixteenth day. Patient reëxamined ten months after the operation (March 22, 1905): had gained 31 pounds in weight and was in excellent health."

CHOLEDOCHECTOMY.

Removal of a portion of the common duct with subsequent complete suture has, so far as I am aware, been performed only on one occasion, by E. Doyen. The case was one of stone impacted in the upper part of the common duct; in extracting the stone the duct was torn through. The frayed ends were trimmed and the ends sutured over a rubber tube. The figures explain the various steps of the operation.

When a part of the common duct is excised various reparative measures may be employed. The ends of the duct may be brought together with or without drainage; the distal end may be closed by a ligature while the proximal is implanted into the intestine; or both ends of the duct may be closed and cholecystenterostomy performed.

Kehr records a case in which a stricture of the common duct was excised. The posterior part of the duct alone was

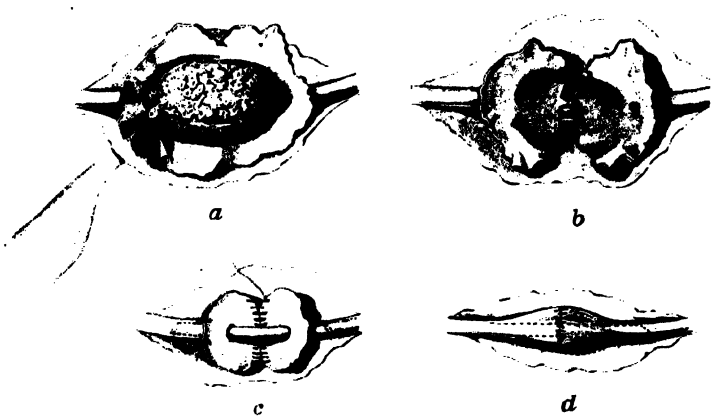


Fig. 275.—Doyen's case of choledochectomy: *a*, Shews the stone in the common duct, just beyond the junction of the hepatic and cystic ducts; *b*, shews the duct ruptured after extraction of the stone; *c* and *d*, the duct sutured after removal of the frayed edges seen in *b*.



Fig. 276.—Excision of growth in common duct.

united; through the anterior part a drainage-tube was passed upwards to the hepatic duct. The patient recovered, though the hepatic cells were so damaged that no bile flowed through the tube at first; for several weeks a very small quantity only was passed. The fistula eventually closed.

In one case I excised a malignant stricture from the upper part of the common duct. The ends of the duct came into easy apposition. About two-thirds of their circumference was

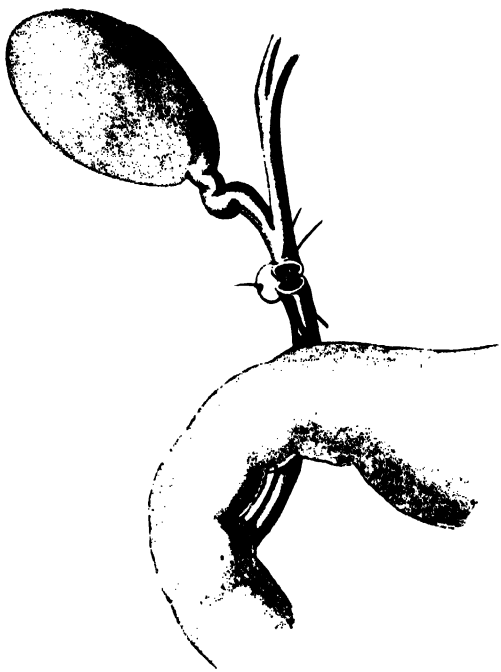


Fig. 277.—Resection of the common duct. End-to-end approximation after resection of a portion of the common duct.

united; the remaining third was left open, and a drainage-tube was left therein. The patient recovered from the operation, but died in three months from recurrence in the glands in the portal fissure.

Waring and Reynier have successfully performed the operation of excision of a part and of the whole of the common duct in dogs. The operation deserves to be remembered, as in certain exceptional instances it may be necessary.

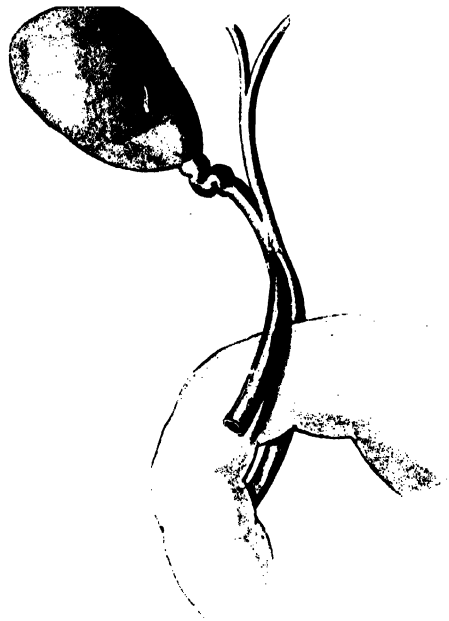


Fig. 278.—Resection of the common duct. Drainage tube introduced into common duct at the suture line of an end-to-end anastomosis.

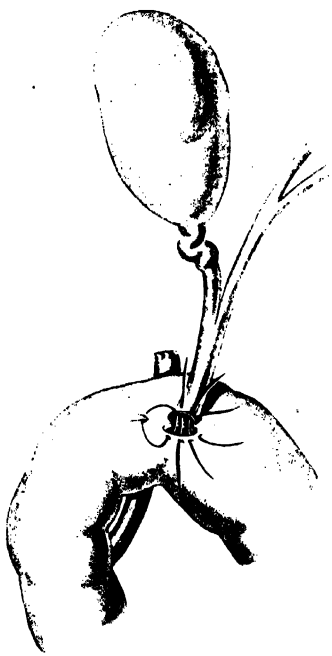


Fig. 279.—Resection of the common duct: closure of the distal opening and performance of choledocho-duodenostomy.

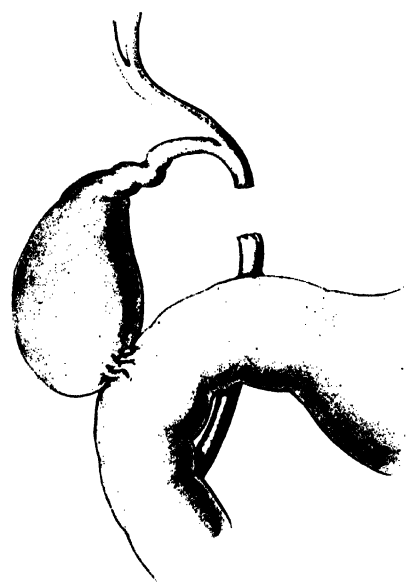


Fig. 280.—Resection of the common duct; closure of both ends and performance of cholecystenostomy

PLASTIC OPERATIONS UPON THE COMMON DUCT.

In certain cases of removal of a stone from the common duct so much damage may be done to the softened, easily lacerable walls that a satisfactory healing without stricture may be impossible. In these circumstances choledochectomy may be performed as practised by Doyen; or the upper end of the duct may be closed by ligature, and cholecystenterostomy be performed;

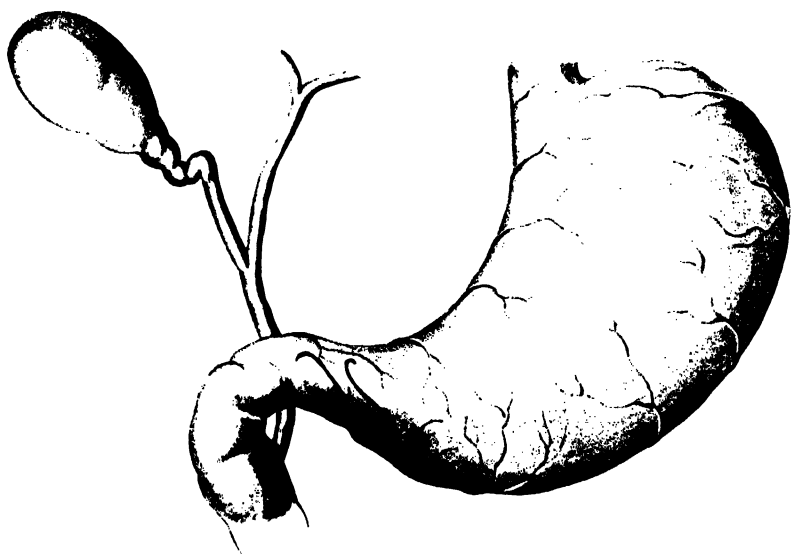


Fig. 281.—Plastic operation upon the common duct. A seromuscular flap is turned upwards from the stomach and sutured along the common and cystic ducts to repair a gap in the former (Kehr's operation).

or the upper end of the duct may be united to the duodenum or stomach or finally a plastic operation may be performed as suggested and carried out in one case by Kehr. This surgeon, in order to repair a rent in the common duct, turned up over the duct a seromuscular flap from the stomach. A reference to the annexed pictures will make it easy to understand the details of the operation.

In one case I have performed a plastic operation upon the common bile-duct. The following are the notes:

M. S. B., aged sixty-three, had suffered for ten to twelve years from the following symptoms: Pain across the epigastrium, rather more on the right side, of the nature of cramp, radiating at times all over the abdomen, and especially to the left costal margin, and to the back of the right shoulder-blade; vomiting, which came on soon after the pain and very often gave relief to it, and jaundice, which was first noticed only eight years ago. There have been "dozens" of attacks of pain followed by vomiting and jaundice. In the end of 1902 and the

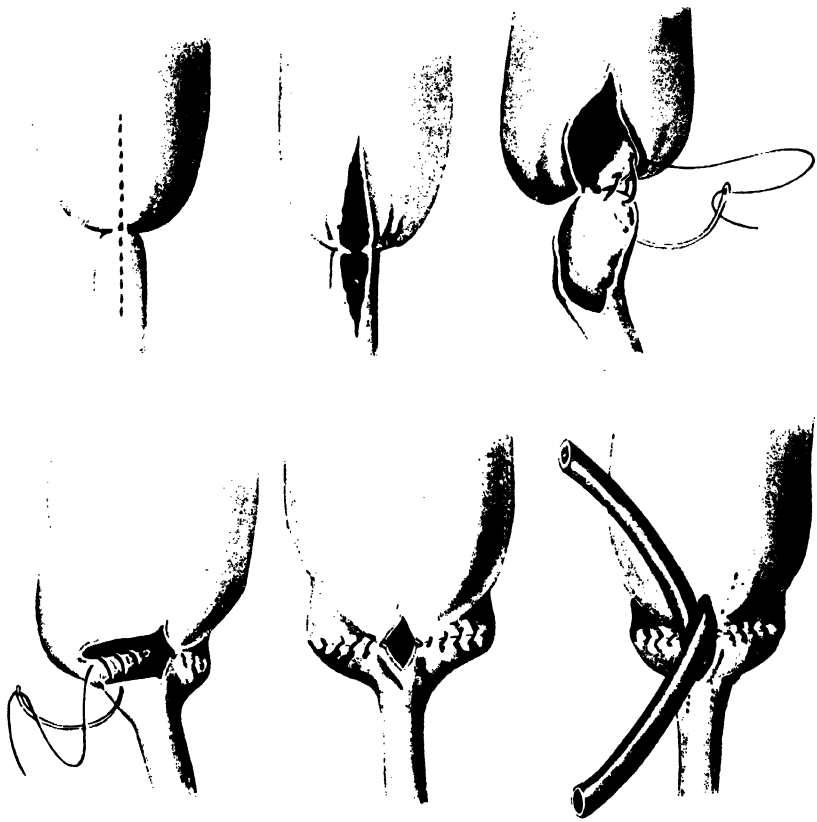


Fig. 282.—Stricture of the common duct treated by a plastic operation.

early part of 1903 the jaundice did not disappear for four months; during this time there were still attacks of pain followed by a deepening of the jaundice, and occasionally slight rigors were experienced. In April, 1903, a gall-stone weighing ½ ounce was passed; it measured 1¼ inch in length, and was ovoid in shape, "like a plover's egg." After this stone passed he was quite well up to December, 1903, when there was an attack of colic followed by jaundice. Until August, 1904, he remained free from attacks; then had a very severe attack of pain followed by jaundice and vomiting. He remained jaundiced up to the time of operation. The jaundice had varied a little, being deeper after attacks

of pain, but, on the whole, has become steadily deeper, and for the last six to eight weeks, during which he had several rigors, it has not lessened at all, but the colour has become progressively darker. He has lost 3 stones in weight, 1 stone in the last eight weeks.

A diagnosis of stone in the common duct was made, and operation advised. The operation was performed December 10, 1904. The abdomen was opened through a vertical incision over the right rectus muscle, the upper end of the cut being prolonged inwards along the costal margin to the middle line. The gall-bladder was slightly adherent, its walls a little thickened, and there were many stones in its cavity. These were removed, but the gall-bladder was not extirpated, in view of the conditions found in the ducts. The common duct was found dilated, forming a cyst-like swelling. It was aspirated, and 11 ounces of bile were withdrawn. The needle being removed, an incision was made into the duct, and a stone the size of a nutmeg withdrawn at once; six other stones were found in the duct. After the dilated duct had been cleared of all easily discoverable stones by a scoop, the finger was passed in the duct upwards to the bifurcation of the hepatic duct, which was also dilated. The finger was then passed downwards, but no orifice could be felt; the inside of the duct seemed smooth everywhere, and no evidence of a passage from the cyst could be discovered. The outside of the cyst was then cleaned by gauze stripping, and the common duct below was defined. It was dilated also; an incision was made into it, and after a little difficulty a probe could be passed upwards into the dilated cyst-like duct. It was clear, then, that there was a narrow stricture of the duct, and that the dilation of the upper part had resulted from the obstruction. Between the two openings now made in the duct, one above and one below the stricture, an incision was made, dividing the stricture completely. Its nature was then seen. It was cicatricial, hard, indurated, and clearly the result of an old ulcer. An attempt was made to perform a plastic operation upon the duct, but it became evident that, despite the distension of the duct, it would be necessary to free the second portion of the duodenum, to "mobilize" it after the manner of Kocher. This was done, and the plastic operation was then readily performed. The stricture, which had been freely divided by a vertical incision, was now abolished by the approximation of the edges of this incision in a transverse direction. A reference to the diagrams will show how this was done. A through-and-through suture of catgut was used, threaded upon an intestinal needle. The transverse wound was not completely closed, sufficient room being left for the introduction of two rubber tubes, one of which passed upwards into the dilated common duct and the other downwards towards the ampulla. Each tube was fixed with a single catgut stitch. The tubes were removed on the eleventh day. For four weeks bile in large quantities, in fact all the bile, passed through the wound. Some pancreatic juice also escaped in this way, as was shown by the digestion of the skin around the wound. In the fifth week, bile began to pass into the intestine, and in the ninth week the wound was entirely closed. The patient was sitting up in bed from the first, and was allowed to get up in the first week.

Since the operation he has been perfectly well, and a report received in January, 1906, says that he has gained 3½ stones in weight, has returned to work, and is in all respects quite well.

OPERATIONS UPON BILIARY FISTULÆ.

External Biliary Fistula.—The treatment of external biliary fistulæ will depend entirely upon the conditions which produce and maintain the patency of the external opening. As a rule, with few exceptions, it will be found that the passage of bile through an external fistula is due to the fact that this is the direction of least resistance. If the bile-ducts are clear and free from narrowing, the bile finds its easiest course along them. After a cholecystotomy it is sometimes, as in cases of chronic pancreatitis, advisable to keep the opening patent for several weeks, and to accomplish this is not seldom a matter of the greatest difficulty. If, therefore, the bile-passages are free, an external biliary fistula will close spontaneously.

One form of external biliary fistula mentioned by both Riedel and Langenbuch is that in which a greatly dilated gall-bladder has been drained after cholecystotomy. The dragging of the gall-bladder fixed in the abdominal wound produces a kink in the common duct, and the passage of bile to the intestine is, therefore, prevented. In such circumstances the gall-bladder may, as Riedel advises, be freed, and the opening into its fundus sutured. A better plan would be to remove the gall-bladder entirely.

If the fistula persist after the operation of cholecystotomy, it probably indicates that a stone is wedged in the common duct. In this and in all cases it is advisable to make bacteriological examination of the bile, and to delay any operative intervention until the fluid discharged is almost sterile.

The treatment, therefore, of an external biliary fistula necessitates, at the first, a very thorough examination of all the bile-tract, and the discovery of the condition which is responsible for the prevention of the normal flow of the bile into the intestine. If a stone be found in the common duct, it will be removed; if there be a stricture of the duct, it also may be removed or cholecystenterostomy may be performed. If there

be a growth or an inflammatory tumour causing obstruction of the duct by pressure from without, or by blockage from within, the fistula may be left as a permanent drain, or a cholecystenterostomy may be performed. If, after the removal of a stone in the duct, it is quite certain that the duct is clear, the gall-bladder may be removed. Kleiber, in 1892 ("Dissert.," Greifswald), had collected the records of thirty cases of fistula in which cholecystectomy was performed.

Internal Biliary Fistula.—The discovery of a fistula between the bile-passages and the intestine will generally be made only during the course of an operation. If the fistula connect the gall-bladder or the cystic duct, on the one hand, with the stomach, duodenum, or colon, on the other, the two united viscera must be separated with the utmost gentleness. The opening into the intestine is then closed by suture, and the gall-bladder is, by preference, removed, or a drain is introduced through the opening. It is of the highest importance in all such cases to make sure that the passage is clear for the bile. If there is a block in the common duct, it must be removed. As a rule, a stone will be found in the cystic duct, in the common duct near the cystic duct, or in the common duct low down. If choledochotomy is performed, it is wiser to afford, through the incision, a direct drainage for some days.

Cases of fistula between the bile-passages and the urinary tract or the lungs may also be dealt with successfully, by operation, the stones which are blocking the hepatic or common duct being removed and free drainage established. Instances are recorded in the chapter dealing with Biliary Fistulæ in my work on "Gall-stones and Their Surgical Treatment."

CHAPTER XLI.

THE SURGICAL TREATMENT OF CIRRHOSIS OF THE LIVER.

The treatment by operation of those cases of ascites due to cirrhosis of the liver in which repeated tappings were necessary, though suggested and carried out in 1889 by Talma and Van der Meulen, owes its established position in the surgical procedures of to-day chiefly to the successful advocacy of Rutherford Morison. The patient under the care of Van der Meulen died almost at once of shock. In 1892 Lens, a pupil of Talma, recorded a case in which the edge of the omentum was sutured into the parietal wound, but the patient was unrelieved by the operation and died six months later, after being tapped on four occasions.

Rutherford Morison's first case, operated upon in 1895, was unsuccessful, but his second case was an unquestioned success. The patient was a woman who lived for two years after the operation, and died after a second operation undertaken for the relief of a ventral hernia which had developed at the site of the wound. Before the first operation tapping of the abdomen was frequently necessary; after the operation it was never needed. It was the success of this case which first attracted prominent attention to the operation.

The principle of the operation consists in the formation of additional venous communications between the systemic and portal circulations for the purpose of relieving the obstruction of the latter. The principle is carried into effect by suturing the omentum to the anterior abdominal wall, where it becomes firmly adherent, and by roughening, by gauze friction the outer surface of the liver and spleen (or even, as suggested by Ito, the mesentery and intestines), so that they too may adhere firmly to the parietal peritoneum.

In all the adhesions so formed vascular channels are soon established. In the postmortem report of Mr. Rutherford Morison's second case, alluded to above, the omentum, the liver, and the spleen were all firmly adherent to the parietal peritoneum by strong bands. In the case operated upon by Lens venous channels were easily formed in the new adhesions which had formed between the omentum and the parietal peritoneum.

The normal communications between the portal and systemic circulations are few; the coronary veins anastomose along the œsophagus with the azygos veins; the veins of the cæcum and colon, with the internal mammary; these are the chief. Though they are capable of great dilatation, they do not afford much relief to the portal system in the oppressive congestion due to cirrhosis of the liver. When, however, a multitude of fresh communications are established, a considerable relief may be afforded.

Rolleston and Turner argue against the view that the new adhesions divert a part of the portal blood-stream; that ascites does not occur when the blood-pressure is presumably highest in the portal vein; that is, in the earlier course of the disease, when hæmatemesis is most often met with; that experimental ligation of the portal vein does not necessarily produce ascites; and that ascites is a late manifestation and appears to be rather a result of the toxæmic condition of the blood than a mere mechanical result of increased portal blood-pressure. They explain the results of Rutherford Morison's operation as being due to the formation of adhesions around the liver, which may be beneficial in two ways: (1) By diminishing somewhat the flow of blood through the liver and so enabling the organ to deal more satisfactorily with the blood passing through it, and so reduce the toxæmic condition of the blood, which is probably the important factor in inducing ascites. (2) By the presence of vascular adhesions allowing a freer supply of arterial blood to the liver. The nutrition of the liver-cells is thus improved,

and they are placed under better conditions for undergoing compensatory hyperplasia.

The conditions in which the operation is indicated are, according to Bunge:

1. Atrophic cirrhosis of the liver.
2. Cardiac cirrhosis: cirrhosis the result of cardiac disease.
3. Pseudo-cirrhosis, with chronic pericarditis.
4. Chronic hyperplastic perihepatitis.
5. Portal stenosis due to thrombosis (rarely).

THE OPERATION OF EPIPLORRHAPHY OR EPIPLOPEXY (TALMA-DRUMMOND OPERATION; DRUMMOND-MORISON OPERATION; TALMA-MORISON OPERATION).

The operation is performed in the following manner: As a rule, local anæsthesia amply suffices; it is in rare cases only that a general anæsthetic need be administered.

The abdomen is opened by an incision in or near the middle line, between the ensiform cartilage and the umbilicus. As soon as the peritoneum is opened the ascitic fluid will escape; it is encouraged to do so, and the pools of fluid in the renal pouches and in the pelvis are mopped with swabs until they are dry. Pains should be taken to see that no fluid is allowed to remain anywhere in the abdomen. The liver is then inspected, and a note of its condition is made. The whole of the upper surface of the liver — all that lies in contact with the diaphragm — is then brought as far into view as possible, and a gauze swab is rubbed with fair vigour over all the surface that is accessible. The spleen is then exposed (it will always be found enlarged) and is similarly treated. The omentum is now brought into the wound, and is sutured to the parietal peritoneum of the anterior abdominal wall. In the now relaxed condition of the abdomen, owing to the escape of fluid which had distended its cavity, the wall can be well everted and that part of it as far from the middle line as is accessible is first united to the lateral margin of the omentum. The same procedure is adopted

on both sides, and a series of sutures uniting the omentum at many points to the parietal peritoneum are passed. The peritoneum may first be roughened somewhat by gauze friction. The more points of adhesion which are ensured between the omentum and the peritoneum the better. In some cases the



Fig. 283.—Epiplopexy (Talma-Morison operation). The omentum may be fixed by a continuous suture or by interrupted sutures. The abdominal wall which is lax after the fluid has been emptied away, is everted as much as possible.

omentum has been sutured between the layers of the abdominal wall, with good result (the method of Schiassi). The abdomen is closed in the usual manner. In the earlier cases a second opening was always made above the pubes, into which a drainage-tube was inserted, but this has been proved to be both

unnecessary and undesirable, in that it has been a source of septic infection.

Results.—The results of this operation on the whole have been satisfactory. The mortality in a series of 105 cases collected by Greenough, however, was high, being, within thirty days of the operation, no less than 29.5 per cent. If this were the death-rate to be expected, it is so high as to be almost prohibitive of the operation. In the recent cases it is probably little more than a quarter of this, owing to the better selection of cases for operation, the necessity for which Dr. Greenough had emphasised. The most favourable cases for operation are those in which the liver is enlarged, rather than atrophied, and those in which perihepatitis is present. The operation is contra-indicated in patients who are in bad condition, in whom the functional activity of the liver-cells is greatly reduced, and in whom advanced renal or cardiac disease is present.

It should be performed, if a reasonable prospect of success is to be assured, as early as possible in the disease, in order that the compensatory hypertrophy of the liver-cells, which is probably one of the causes of the improvement in the patient's condition, may have time to develop.

Monprofit, of Angers, in an extremely good summary of the subject ("Traitement Chirurgical de la cirrhose du foie," Paris, 1904), has collected the notes of 224 cases. In 213 the result of the operation was known. He gives the following table:

Fatal cases	As a result of operation		42 cases.
	Shock		9 "
	Infection		7 "
	Other accidents		26 "
	Subsequent to operation	Cachexia	30 "
		Other concomitant disease	12 "
Cases recovering from operation	Recurrence of effusion		25 "
	Improvement		26 "
	Recoveries		70 "
	Patient's history not obtainable		8 "

The mortality of the operation was, therefore, 42 cases in 224, approximately 20 per cent. The post-operative mortality is also 20 per cent.

Monprofit points out that complete recovery has followed oftenest in the cases operated upon early, when the cirrhosis was not too advanced.

The procedure of Schiassi, the "intramural operation" of



Fig. 284.—R. P., before operation. Shews the distension of the abdomen, with some venous trunks coursing up towards the axilla (Morison).

the Americans, was adopted in 35 cases, with 13 deaths and 22 recoveries. Of these 22, 4 cases recurred, 3 were not followed, 6 were improved, and 9 cured.

The method of Schiassi, therefore, offers no advantages over the original operation of Talma.

By the courtesy of my friend, Mr. Rutherford Morison, I am enabled to give two photographs of a patient upon whom he operated. The following are the notes of this case:

"R. P., aged fifty-two years, was admitted to the Royal Infirmary, Newcastle-upon-Tyne, on February 27, 1899. Six months before he had begun to have occasional swelling of the

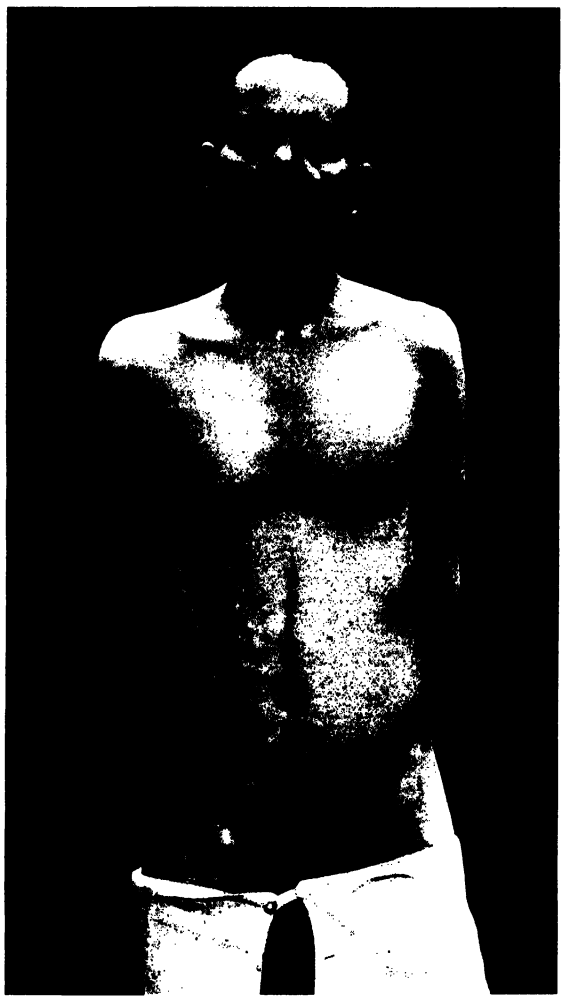


Fig. 285.—R. P., three and one-half years after operation. Shews the enlargement of the epigastric vein on the right side. The line of the incision above the umbilicus and the site of the drainage-tube below it are also seen (Morison).

abdomen, attended by a dull aching pain and swelling of the legs and feet. Three and a half months later the abdominal swelling and pain became permanent and the swelling steadily increased. He had felt sick at times, but had never vomited.

His urine had been scanty, high coloured, and thick on cooling. The bowels were constipated, but no blood had been noticed in the motions.

"*Previous History.*—He had had a rupture in the left groin for many years, which had grown more troublesome lately. Two and a half years ago he was treated in the Newcastle-on-Tyne Infirmary for delirium tremens. Previous to the attack he had been a heavy drinker; since then he had abstained entirely from alcoholic drinks. He had never had syphilis or other serious illness.

"From the time of his admission until the operation in August he was under the care of Dr. George Murray, to whom I am indebted for the following note: 'The main line of treatment has been as follows: Limitation of fluids taken; regular administration of mist. purg. alb., and tapping of the abdomen on left side by means of Southey's trocar. Girth at umbilicus before tapping, 36 inches.

Date of Tapping.	Quantity Removed, Fluid Ounces	Girth of Umbilicus after Tapping, Inches.
March 11	285	31
March 25	197	34
April 1	122	34½
April 8	317	32
April 20	114	35
April 30	97	34½
May 10	169	
May 20	176	
May 30	186	
June 11	167	
June 21	204	
July 2	212	
July 22	330	
August 9	354	
Total	2930 fluid ounces—18 gallons, 2½ pints.	

"The case was discharged from the medical wards on August 17, 1899.

"On admission to the surgical ward his condition was described as follows: He was a thin man, with sallow complexion, sunken cheeks, and yellow-tinted conjunctivæ. His tongue was clean and moist, appetite fairly good, arteries slightly atheromatous; pulse 92 and temperature normal.

No jaundice or other disease discovered beyond what follows. His abdomen was much distended, and the physical signs were those of a large collection of free fluid. The left side of the scrotum was swollen from fluid distending a hernial sac.

"Dilated subcutaneous veins were visible, starting from the neighbourhood of the umbilicus and terminating in one large trunk on either side, which ran up over the chest into the axilla. The direction of the blood-current in them was ascertained to be from below upwards. Percussion showed an increased splenic and diminished liver-dulness. There was some œdema of the feet and legs, extending as far as the middle of the calf.

"On August 29, 1899, the patient was operated upon, under chloroform. An incision about four inches long opened the abdomen between the ensiform cartilage and the umbilicus. The cut subperitoneal fat was vascular and bled freely. A large amount of clear, straw-coloured fluid escaped as soon as the peritoneum was divided. A second opening was next made, between the umbilicus and pubis, large enough to admit a half-inch diameter glass drainage-tube, which passed through it into the pelvis. Some adhesion was present between the liver and the omentum and between the omentum and the abdominal wall. The liver was firm, finely granular on the surface, and of about normal size. The spleen was hard and enlarged to at least double its normal size. The abdominal cavity was dried with sponges, special care being taken to rub the surface of the visceral peritoneum opposed to them. The omentum was fixed across the anterior abdominal wall by catgut sutures.

"The upper incision was entirely closed by catgut sutures. The lower was kept open for a drainage-tube, through which the fluid was pumped out of the pelvis. Over the dressings, broad, long strips of adhesive plaster were applied transversely from the chest above to the drainage-tube opening below. This was for the purpose of keeping the upper part of the abdominal cavity empty of fluid and the parietal closely applied to the visceral peritoneum.

"Two nurses with a reliable knowledge of antiseptic wound treatment were told off to look after the tube and keep any fluid

from collecting in the pelvis or from escaping on to the dressings.

"The operation was well borne and his recovery straightforward. The following shews the amount of fluid removed daily from the tube:

1899.			1899.		
August	29,	℥xxiii.	September	16,	℥xvi, ℥v.
"	30,	℥xii.	"	17,	℥xxi, ℥vi.
"	31,	℥xix.	"	18,	℥xiv, ℥vi.
September	1,	℥xvii.	"	19,	℥xvi, ℥i.
"	2,	℥xix.	"	20,	℥xiv, ℥i.
"	3,	℥xiii.	"	21,	℥xiv, ℥iv.
"	4,	℥viii.	"	22,	℥xvi, ℥iii.
"	5,	℥xvi.	"	23,	℥xiv, ℥iii.
"	6,	℥xiv.	"	24,	℥xvii, ℥x.
"	7,	℥xi.	"	25,	℥xvi, ℥vi.
"	8,	℥xiii.	"	26,	℥xv, ℥vi.
"	9,	℥xiv.	"	27,	℥xiii, ℥vi.
"	10,	℥xiii.	"	28,	℥xi, ℥v.
"	11,	℥xiii.	"	29,	℥xix, ℥iv.
"	12,	℥xi.	"	30,	℥xvi, ℥iii.
"	13,	℥xiv.	October	1,	℥xix, ℥v.
"	14,	℥xvi.	"	2,	℥x, ℥i.
"	15,	℥xv.	"	3,	℥xii, ℥vii.
			"	4,	℥xii.

"October 9.—For the last few days very little fluid had escaped from the tube. There was some œdema of the scrotum and subcutaneous tissues of the back.

"October 10.—The tube was removed. There was no fluid escaping from it.

"October 16.—Patient very well; appetite good; quantity of urine, 63 ounces; the abdomen was a little distended; it measured 24 inches around the umbilicus. There was dulness on percussion in left flank, reaching as far forward as the anterior axillary line. This disappeared on turning over. The veins of the abdominal wall were not so prominent, and there was much less œdema of the scrotum and back.

"Three weeks after the patient left the Infirmary (December 17, 1899) he returned with signs of a large fluid collection in the abdomen; 230 ounces were removed by tapping. He had passed only about 18 ounces of concentrated urine daily.

"January 3, 1900.—Better; signs of very little fluid in belly.

"From this date there was no further accumulation of fluid, and at the present time (February, 1903) 'he is very well; never looked better; is fat and strong, and has a good appetite. There are no signs of fluid in the abdomen. The veins in the abdominal wall are very large. He complains of some dragging pain in the abdomen; the liver can be felt adherent to the abdominal wall.' (Note by Mr. G. Grey Turner, Surgical Registrar.)"

This subject is fully dealt with in a recent monograph by Bunge, "Die Talma-Drummondsche Operation," Jena, 1905. A brief summary of 255 recorded cases is given.

SECTION V.

OPERATIONS UPON THE PANCREAS AND SPLEEN.

CHAPTER XLII.

OPERATIONS UPON THE PANCREAS.

THE pancreas, for the purposes of operation, may be approached from the front or from behind. In the great majority of cases the former route is preferable.



Fig. 286.—Exposure of the pancreas. The position of the pancreas in relation to the stomach when the gastrohepatic omentum is incised is shewn.

APPROACH FROM THE FRONT.

A sand-bag having been placed behind the lower part of the chest, the abdomen is opened by an incision between the

ensiform cartilage and the umbilicus, in the middle line, or to one or other side of it, as seems necessary for speedy access to the part to be treated. When the peritoneal cavity is opened, the pancreas may be reached in five ways: (*a*) Above the stomach, through the gastrohepatic omentum; (*b*) through the stomach, both walls being incised; (*c*) below the stomach,

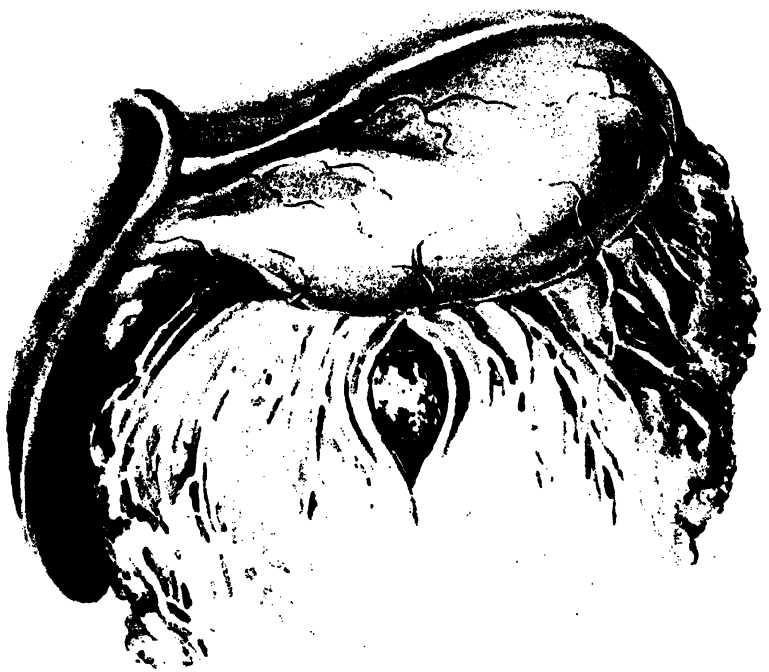


Fig. 287.—Exposure of the pancreas; the lesser sac is opened by an incision in the great omentum immediately below the greater curvature of the stomach. The stomach is pushed upwards.

through the gastrocolic omentum; (*d*) through the transverse mesocolon; (*e*) in addition access to the posterior part of the head of the gland may be obtained by Kocher's method of "mobilising the duodenum."

(*a*) **Above the Stomach.**—In thin people in whom visceral prolapse is present the pancreas may often be recognised on palpation as a mass lying transversely a little above the um-

bilicus. Indeed, a mistaken diagnosis of tumour in the stomach has not seldom been made in these circumstances. If the abdomen of such a patient be opened, the pancreas can be seen quite clearly through the thin, diaphanous gastrohepatic omentum. A small incision through this omentum rapidly enlarged will then give easy access to the gland.

(*b*) **Through the Stomach.**—This method is one which, so far as I am aware, has been deliberately undertaken only on



Fig. 288.—Exposure of the pancreas. The transverse mesocolon is incised as in posterior gastro-enterostomy.

one occasion. The operator was Hagen, and the case concerned a boy aged thirteen, in whose abdomen a cyst the size of a child's head was discovered. It lay behind the stomach and was surrounded by such strong adhesions that it was impossible to bring it to the abdominal wall. The anterior wall of the stomach was, therefore, incised, and subsequently the posterior wall, and the cyst contents were then readily evacuated. The flaccid wall of the cyst was then, with great difficulty and after displacement of the stomach and resection of the

costal margin, brought into contact with the parietal peritoneum.

(*c*) **Below the Stomach.**—This is the route which has been chosen by the majority of operators. A bloodless spot in the omentum immediately below the greater curvature of the stomach is selected, and a small tear therein is made and slowly enlarged. The lesser sac of the peritoneum is thus opened,

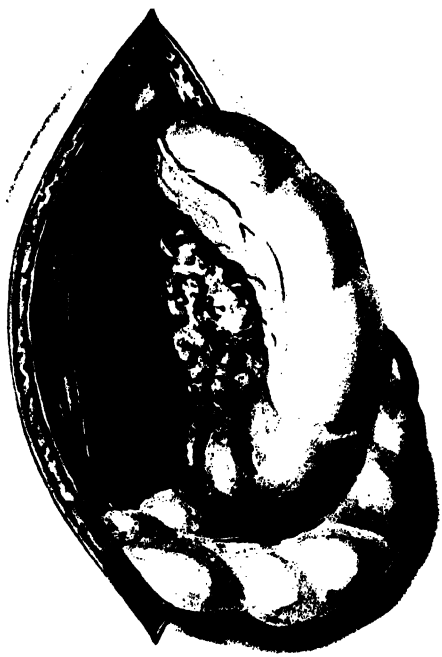


Fig. 289.—Exposure of the pancreas. The peritoneum to the outer side of the second portion of the duodenum is incised and the duodenum is raised up towards the middle line. The posterior part of the head of the pancreas is exposed.

and through the posterior wall of this sac the pancreas can be reached. If a cyst of the pancreas be present, it will often be found to bulge forwards below the stomach and to be reached very readily by an opening made in the position described.

(*d*) **Through the Transverse Mesocolon.**—The omentum and the transverse colon are turned upwards as in the performance of the operation of gastro-enterostomy. The transverse meso-

colon is then incised in a spot devoid of blood-vessels; a finger is passed through into the lesser sac, and the opening gradually enlarged by gentle tearing. This route is that to which the preference is given by Krönlein, but it is obvious that if drainage is necessary, it is unsatisfactory.

(*e*) The posterior part of the head of the gland may be exposed by incising the peritoneum to the right of the duodenum and stripping the second part of the duodenum upwards towards the middle line.

Approach from Behind.—The pancreas may be reached by an incision in the left loin, commencing at the tip of the twelfth rib, and extending obliquely forwards to the umbilicus. Peters has operated in this way upon a hydatid cyst of the tail of the pancreas, and in several cases supplementary drainage, in cases of acute or subacute pancreatitis, has been established.

THE SPECIAL CIRCUMSTANCES IN OPERATIONS UPON THE PANCREAS.

There are two circumstances of the highest importance in connexion with operations upon the pancreas.

The first refers to **hæmorrhage.** The pancreas has a blood-supply in proportion to its requirements as the gland by which the most important of the digestive juices is secreted. It is extremely vascular, and its blood-vessels are both large and numerous. Any injury of the gland, therefore, causes free bleeding, bleeding which is, moreover, very difficult to control. When, as the result of direct incision, bruising by external force, or tearing during the removal of growths involving the stomach or the pancreas itself, hæmorrhage occurs, it is not possible, in the majority of cases, to arrest it by ligature. The simple tying of a mass of the exceedingly fragile tissue of the pancreas often results in the ligature cutting through, and consequently in a further onset of bleeding. The individual vessels in the gland cannot be secured. The only means of arrest of the hæmorrhage is, therefore, the use of deep sutures of material—silk or catgut—sufficiently thick to prevent its cutting through the gland when the stitch is drawn tight. And this

method in itself is unsatisfactory, for it causes, necessarily, such damage by compression and strangling of the soft gland substance that sloughing is not unlikely to occur.

The second refers to **the escape of the pancreatic juice.** It has been shewn, both by experimental work and by observations made upon cases submitted to operation, that after the pancreas has been incised, bruised, or torn, its special secretion is poured out from the wound-surfaces. The experimental work of Simon Flexner, Biondi, Katz and Winkler has shewn that when the pancreas is so damaged, by injury however produced, that its vitality is lowered, there is an escape of the gland secretion into the parts around. The observations of Ruggi and Biondi and other operators who have removed parts of the gland for simple or malignant growths shew that a free outpouring of secretion occurs from the cut surfaces. The result of this is that fat-necrosis occurs, as well as an active digestion of the tissues with which the juice comes into contact. An acute inflammation of the pancreas, with or without hæmorrhage or subacute or chronic pancreatitis, may thus result. In one case, recorded by Koester, an injury to the pancreas during the course of an operation was followed by fat-necrosis. The digestion, by the pancreatic juice so freely poured out, results in the provision of an admirable culture-material for any organisms that may chance to be present. Infection of the wound area is almost inevitable to some extent in operations, necessarily difficult and prolonged, upon the pancreas. An infection that the healthy peritoneum could certainly deal with becomes of the utmost virulence when an abundant food-supply for the organisms is present. As Professor von Mikulicz says, the secretion of the pancreas does not flood the peritoneal cavity in such quantities that it proves fatal by mere absorption; "it acts indirectly by reason of the local irritation of the peritoneum, in that it prepares a nutrient medium for bacterial invasion and makes infection extremely easy." It is almost certain that in all abdominal operations some germs enter the peritoneal cavity. When their numbers are few, the

unharmed peritoneum can resist them without difficulty, but if the natural powers of resistance of the peritoneum are greatly reduced, they may be competent to produce an acute inflammation.

A further source of danger lies in the digestive action of the pancreatic juice upon the adhesions which the peritoneum produces. The outpouring of lymph is the chief means possessed by the peritoneum of protecting itself from harm; when the thick flakes of lymph are speedily digested by the pancreatic secretion, the avenue for a further extension of septic trouble is at once opened.

The secretion from the injured or inflamed pancreas is able, according to Mikulicz, to cause, in itself, a variety of aseptic peritonitis, which is followed by intestinal paralysis and obstruction.

The lesson to be drawn from these facts is that in all cases of operation upon the pancreas, where there is any likelihood of the escape of the secretion, free drainage should be provided. The escape of secretion from a wound of the pancreas can be prevented by accurate suture and by the careful closure of the peritoneum over the wound in the gland. Successful cases where this has been performed are recorded by Ninni and Mayo Robson. If this sealing-off cannot be secured, the need for drainage is imperative. Its value is well shewn by the statistics given by Mikulicz. In 12 cases of injury to the pancreas, the result of blunt force, or stab or gunshot wounds, 8 were drained, and of these, 6 recovered; 4 were not drained, and the only one that recovered was that recorded by Ninni, in which the peritoneum was securely closed over the wound.

The peculiar difficulties and dangers attaching to operations upon the pancreas will, therefore, be readily understood. Bleeding is apt to occur and is difficult to arrest. Escape of pancreatic juice is almost constant; it can produce an aseptic peritonitis, or digest adhesions poured out by the peritoneum for its own protection, or, finally, by acting upon the blood so constantly present, on the pancreas itself, and on all the parts around, a culture-medium is provided which is eminently suited to ensure the very rapid growth of organisms.

CHAPTER XLIII.

INJURIES OF THE PANCREAS.

THE pancreas is rarely injured. This is owing in part to the deep position it occupies in the abdomen, and in part to the shelter afforded to it by the ribs and by those viscera which lie over it. The number of cases in which the pancreas has been injured is, however, probably assessed too low, for a wound of the gland is quite likely to be overlooked.

In the majority of cases an injury to the pancreas is not the only damage which is inflicted; the liver, the stomach, the kidneys, and the intestine are, one or all, likely to suffer at the same time. The blow which causes the injury generally impinges upon the epigastrium and is directed from before backwards.

There are no special signs or symptoms indicative of injury to the pancreas. In deciding upon an exploratory operation in a doubtful case the surgeon has, therefore, to rely upon the symptoms of shock, hæmorrhage, and, in the later stages, peritonitis. Reliance must especially be placed on the steady increase in severity of these symptoms. There will almost certainly be a sufficient warrant for operation in the conditions of other organs than the pancreas; and the danger is that, as in several recorded cases, the surgeon may be content in dealing with these other injuries, and overlook the wound which has been inflicted upon the pancreas. An emphatic rule should be laid down that in all cases of injury to the upper part of the abdomen, in those cases especially where the injury has fallen upon the epigastrium, no operation is to be considered complete until an examination of the condition of the pancreas has been made.

OPERATION.

The abdomen is opened, as a rule, through the middle line, or close to it, by a vertical incision between the ensiform cartilage and the umbilicus. As soon as the peritoneum is opened a general inspection of the parts likely to have suffered injury is made. No pains must be spared to make this inspection as thorough as possible, for an oversight will perhaps prove fatal. If a wound of the liver, stomach, or intestine be met with, it is dealt with in the manner which has already been described.

The pancreas is then examined. As a rule, the route above the stomach will be selected. The gastrohepatic omentum



Fig. 290.—Method of suture of a wound in the pancreas. Two or three deep sutures of stout catgut or silk are passed, and the wound-surfaces drawn together. The wound-edges are then sutured with fine catgut sutures.

is torn through and the lesser sac is opened. Extravasated blood and pancreatic juice will often be found in the lesser sac, and a general mopping-up of these fluids will be necessary. Especial care is taken to see that this fluid, for reasons that have already been mentioned, is not allowed to escape into the general peritoneal cavity.

When the parts are thoroughly dried and the general peritoneal cavity has been protected in the usual manner by a double layer of large flat swabs, the hæmorrhage from the gland must be arrested, and an attempt made to suture the wounds. The hæmorrhage is best arrested by deep sutures of stout catgut, or, in certain cases, by the ligation, *en masse*, of an area which is oozing freely. As a rule, the placing of deep sutures checks

the hæmorrhage and draws together the margins of the wounds in the gland.

It is then necessary to adopt measures to prevent the escape of the pancreatic secretion into the peritoneal cavity or into the subperitoneal tissues. This has been done in two cases by the accurate suture, over the gland, of the peritoneum which covers it, the layer, that is, which forms the posterior part of the lesser sac. In the majority of cases, however, this sealing-off is neither prudent nor possible, for a secretion from the gland is very likely to be poured out, and if it is, a free escape should be provided for it. Drainage by tube or gauze is consequently almost always necessary, and is certainly always desirable. Drainage may be established through the anterior wound, or a posterior incision may be made, a large rubber tube or gauze packing introduced, and the anterior wound may be closed.

Professor von Mikulicz ("Annals of Surgery," July, 1903) has collected the records of 45 cases of pancreatic injury. There were 21 cases of penetrating wounds and 24 of subcutaneous wounds from blunt force. Of the 21 cases of penetrating wounds, 12 were due to gunshot and 9 to stab wounds. Five of the 12 gunshot wounds were operated and 3 recovered; 7 were not operated upon and all died. The 3 successful cases were recorded by Otis, Hahn, and Ninni. Ninni's case was one of revolver wound of the abdomen in a man aged twenty-seven. The patient had run more than 500 yards after the wound had been inflicted, but was brought to hospital, collapsed, almost unconscious, with thready pulse, and the abdomen painful and tympanitic. The bullet had entered close to the second lumbar vertebra, and, after passing through the pancreas, had made six wounds in the small intestine and one in the colon at the hepatic flexure, and had finally come out in the right epigastric region. An incision was made from the ensiform cartilage to half-way between the umbilicus and the pubes, giving vent to blood and gas. The seven intestinal wounds were sutured, and then, as blood was seen to ooze from between the

stomach and transverse colon on the right side, a transverse incision was made, the gastrocolic omentum opened, and a wound of the pancreas at the junction of the head and the body disclosed. Two deep sutures were passed which arrested the bleeding. Drainage was established. The patient left the hospital in thirty-five days. In 7 of the 9 stab wounds the pancreas was prolapsed in part; in 2 it was replaced; in 5 it was sutured or ligated and replaced; all these patients recovered. In only 2 of the 9 stab wounds was there intra-abdominal injury of the pancreas; in these 2 only, therefore, was there the risk of contamination of the general peritoneal cavity. These two cases were recorded by Küttner and Hildebrand. In Küttner's case there was a deep wound of the body of the pancreas which almost divided it into two portions. The wound-edges were drawn together by two sutures and a superficial stitch of catgut. Hæmorrhage was in this way completely and at once arrested. In this case there was also a wound in the stomach, which, being found at once on opening the abdomen, was temporarily closed by a Doyen's clamp until the suture of the pancreas was completed. Drainage was provided by a large packing of gauze. A subphrenic abscess formed, and was opened on the twelfth day. On the eighteenth day the patient was up, and at the end of four weeks was sent home quite well.

In Hildebrand's case there was also a perforation of the stomach as well as an injury to the pancreas. The bleeding points in the pancreas were secured by individual ligatures; the stomach wound was closed; no drainage was provided. Death occurred on the fourth day.

Of the 24 subcutaneous injuries, 13 were not operated upon and all died; 11 were operated upon and 7 recovered; the operation consisted in exposure of the pancreas and drainage.

In some of the late operations little more was done than to evacuate some old disintegrating blood-clot and to provide drainage.

The principles which should be observed, therefore, in all operations upon the pancreas for injury are these:

1. Bleeding must be carefully arrested by ligature *en masse* or by suture; preferably the latter.
2. If the tail of the gland is very badly crushed, a resection must be performed.
3. If the duct of the gland is exposed, care must be taken to see that the sutures do not penetrate the duct.
4. Free drainage, through the anterior wound, through a special posterior wound, or through both, must be provided.

Professor Garré ("Beiträge zur Klinischen Chirurgie," June, 1905, Bd. 46, Heft 1) reports from his clinic in Königsberg a case of total transverse subcutaneous tear of the pancreas only, in which a successful operation was performed. The patient, a man of twenty-four, had been crushed in the upper abdominal region between two buffers of a train. There was some little pain after the accident, no vomiting or nausea, no shock, and pulse and temperature were normal. The abdomen was tense and there was some tenderness in the epigastrium. Three hours after the injury, vomiting of coffee-grounds material and later of some blood set in, with severe pain. The diagnosis of rupture of an intestine was made, and an immediate laparotomy followed. A considerable amount of blood was found in the abdomen, and after an examination of the other organs in the peritoneal cavity had shown them to be intact, the blood was discovered coming from behind the stomach, which was somewhat low in the abdomen, but uninjured. Tearing through the lesser omentum, above the stomach, a complete tear in the pancreas was found, the edges of which were about the thickness of a thumb apart. The edges were sharp, as if cut with a knife. The splenic vein was intact. The severed tail of the pancreas was about 10 cm. long.

The torn edges of the organ were brought together into exact apposition, and with three posterior and three anterior fine silk sutures through capsule and parenchyma the defect was repaired and the hæmorrhage stopped. The sutured portion was isolated by tampons, gauze was put around the pancreas wound and up under the liver, and was brought out of the original incision. There were no areas of fat necrosis (Fig. 291).

The progress of the case was most pleasing. The pains ceased at once. For two days there was vomiting of blood-stained fluid. On the third day the tampons were saturated with pancreas secretion, and in the subcutaneous fat layer there were three areas of fat necrosis. The secretion was examined, and showed

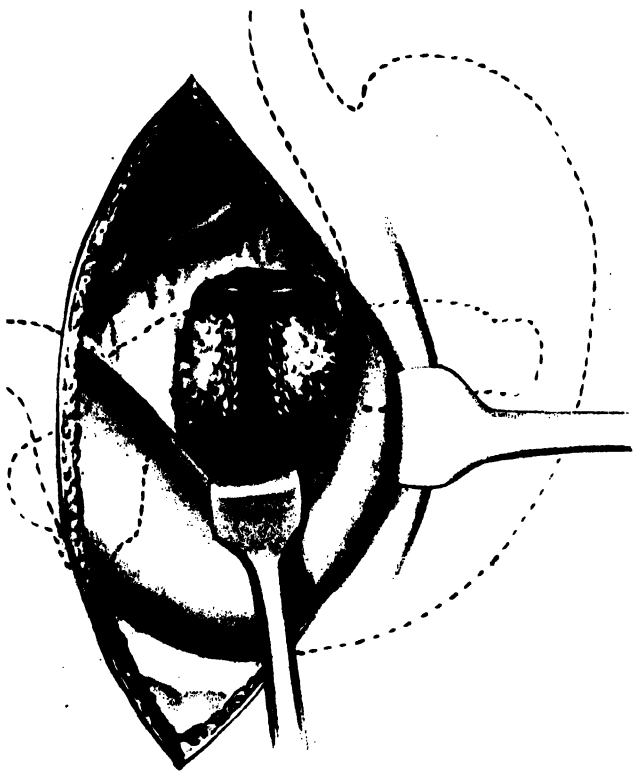


Fig. 291.—Complete transverse rupture of the pancreas, treated by suture (Garré).

all the pancreatic enzymes. The first tampon was removed after eight days and a new loose one inserted. In two weeks a drain was put in. The secretion became less and less, and in two weeks more the drain was omitted. In about six weeks the fistula was closed.

CHAPTER XLIV.

INFLAMMATORY CONDITIONS OF THE PANCREAS.

ACUTE PANCREATITIS.

Acute pancreatitis is one of the most serious diseases which the surgeon is ever called upon to treat.

There has been much confusion from a want of clearness in the terms which have been used to describe the various forms or stages of the disease.

Acute inflammation, in the majority of cases, is attended by hæmorrhage, which may be localised to one part of the gland, affect the whole gland, or involve also the parts around. There is even yet a want of agreement among those whose experience in the matter is considerable, as to whether, as a rule, the hæmorrhage precedes the inflammation and causes it, or whether the inflammation occurs first and results in the hæmorrhage. There can be no doubt, however, that inflammation may occur without hæmorrhage, and that hæmorrhage, even fatal in character, may occur without inflammation. In the majority of instances, however, the two conditions are found together. Mayo Robson is inclined to believe that a differentiation of cases is sometimes possible, the ultra-acute cases having a violent and sudden onset, accompanied by collapse, ending fatally with extreme rapidity, being, for the most part, those where the hæmorrhage precedes the inflammation; whereas the cases which are still acute, though somewhat less so, where the onset is more gradual, where the symptoms are not ushered in by collapse, and where resolution and relapse are likely to occur, are those in which inflammation precedes the hæmorrhage. There is no doubt that the three forms of pancreatitis described by Fitz—the hæmorrhagic, the gangrenous, and the suppurative

—are merely different stages of the same disease and are alike in their etiology.

Mikulicz considers that pancreatic apoplexy is distinguished from acute hæmorrhagic pancreatitis only by the bacterial conditions: the former is an aseptic process; the latter, a septic process.

The influence of the pancreatic ferments in cases of injury to the gland is considerable. As Mikulicz points out, the following vicious circle is established: "Small hæmorrhages or disturbances in circulation (from arteriosclerosis, embolus, thrombosis); from this, necrosis of a small area of the gland; infiltration around this focus of the ferments set free by the destruction of the parenchyma cells; digestive changes in the surrounding tissue and its vessels, which were until this time unchanged; enlargement of the hæmorrhagic focus, partly as a direct result of the erosion of the vessels and partly as the result of the undermining of the tissues and the increased pressure from the hæmatoma; necrosis and destruction of the surrounding parenchyma of the gland; further escape of the ferments," etc.

The escape of the ferments of the pancreatic juice from the damaged portion of the gland is responsible for causing the characteristic signs of acute pancreatitis, fat-necrosis, localised peritonitis, and, in the later stages, when infection is added, pancreatic abscess.

The occurrence of acute inflammation in the pancreas attended by hæmorrhage is clearly a condition which calls for early operation, for unless the tension is relieved and free vent given to the pent-up exudates, the local and general manifestations are hardly likely to do other than continue.

The **symptoms** which are present in acute pancreatitis are those of an acute epigastric peritonitis. No more succinct description has been given than that which Fitz embodied in his first article upon the subject, "Acute pancreatitis is to be suspected when a previously healthy person or sufferer from

occasional attacks of indigestion is suddenly seized with violent pain in the epigastrium, followed by vomiting and collapse, and, in the course of twenty-four hours, by a circumscribed epigastric swelling, tympanitic or resistant, with slight rise of temperature." In two out of three cases upon which I have operated the most striking feature has been the general lividity of the skin; the face has looked suffused, the lips blue, and the body surface has been damp, cold, and leaden-hued.

The onset of the symptoms is always acute; collapse and pain are well marked, and arrest of intestinal movement soon follows. The appearance and the conditions suggest a diagnosis of those other abdominal catastrophes, a perforating ulcer of the stomach or duodenum and intestinal obstruction.

Operation.—In many cases operation will be undertaken without a positive diagnosis having been made. The surgeon will feel that some acute catastrophe has occurred in the abdomen, and that in operation alone lies the hope of relief. In one of my three cases a diagnosis of acute pancreatitis was made; in the other two, a diagnosis of perforated ulcer of the stomach or duodenum; though in one, the question of pancreatitis was considered.

The incision will, therefore, owing to the localisation of the signs, be made in or near the middle line above the umbilicus. As soon as the abdomen is opened, a deeply blood-stained fluid will escape. The omentum, which will probably present in the wound, shews almost always the small round white or pale-yellow patches which indicate the presence of fat-necrosis. The discovery of these patches is quite enough to enable the surgeon instantly to recognise the nature of the disease and to make the operation purposeful, which, until this point, had been exploratory. An inspection of the gastrohepatic omentum, the stomach, duodenum, gall-bladder, and bile-ducts is then made. The pancreas will be found engorged with blood, soft, swollen, and purplish in colour. The surgical indication is then at once to afford relief to the pancreas, which is in a con-

dition of phlegmon. The same measures are necessary as in phlegmonous inflammation elsewhere. The gland must be exposed freely by tearing through the gastrohepatic omentum; multiple punctures or small incisions must be made into the gland, and free drainage must be secured.

The need for the relief of tension and for free drainage are, indeed, the circumstances of chief importance. A large gauze packing may be introduced through the anterior abdominal wound, or a second posterior incision may be made in the left costovertebral angle, and the pancreas exposed from behind, punctured freely, and large drainage-tubes introduced. In some cases both anterior and posterior drainage may be profitably established.

In a certain number of the cases gall-stones will be discovered when the gall-bladder is examined. These should be removed and the gall-bladder should be drained, if time permits. It should not be forgotten that in many cases, as Opie was the first to shew, the onset of the acute inflammation in the pancreas is due to the blocking of the ampulla of Vater by a small stone, and the conversion, thereby, of the common bile-duct and the duct of the pancreas into a common channel; as a result of this, bile, which is infective, escapes into the duct of Wirsung, and sets up the acute inflammation of the pancreas. The removal of the offending stone can hardly be carried out in any case of this kind, owing to the bad condition of the patient, but if cholecystotomy is performed, the bile will be drained away from the hepatic duct, and the removal of the stone, if the stone does not escape into the duodenum, may be carried out later.

This method of treatment—the free exposure of the pancreas, its puncture, and the provision of free drainage, followed or not, as may be deemed necessary, by cholecystotomy—is that which should always be followed. There were on record, according to Mikulicz, up to May, 1903, 75 cases of operation for acute pancreatitis. Of 37 cases in which the pancreas was involved

in the operative interference, 25 recovered; in 41 where the pancreas was not touched, 4 cases recovered, and in all of these free peritoneal drainage was established. In one of these cases the intestine was drained by the performance of typhlotomy. If intestinal paralysis is a prominent feature in the case, this should certainly be done.

It is to Dr. Muspratt and Dr. Ramsay, of Bournemouth, that acknowledgment is due for their putting into practice for the first time, fortunately with success, the principles of the operation which have just been laid down. In the "British Medical Journal" (February 6, 1904, p. 304) the brief record is given of a case operated upon on December 2, 1902. The patient was a woman, aged forty, who, after a long period of abdominal suffering, was suddenly seized with severe pain, collapse, and incessant vomiting. The abdomen was opened within twenty-four hours. The omentum and the intestines in the neighbourhood of the pancreas were found deeply blood-stained, and there were numerous areas of fat-necrosis. The pancreas was swollen, tense, and purple in colour. It was decided "to try the result of relieving tension" in such a case, and a free incision into the head of the pancreas, which was more especially affected, was made. Free bleeding followed, which was checked with some difficulty. A gauze drain was introduced and the patient made a speedy recovery. The case recorded in Professor Mikulicz's paper in the "Annals of Surgery" of May, 1903, operated upon by Dr. Porter, of Boston, though recorded first, was, in point of time of performance, second to this.

SUBACUTE PANCREATITIS.

Gangrenous and suppurative pancreatitis are the conditions which result from an infective process which is rather less acute than that just described. There is a difference in the intensity, rather than in the character, of the infection.

The plea has been urged that in cases of acute pancreatitis operation should be deferred, because if the condition is left

to itself and gangrene or abscess of the pancreas result, operative treatment then is far less serious and attended by a greatly reduced mortality. This argument is grossly misleading, for it takes no account of the number of cases of acute pancreatitis in which the processes are so rapid, and the course of the disease so acute, that the patient dies before either suppuration or gangrene—leisurely processes both of them—has developed. The symptoms and the mode of onset in abscess of the pancreas are similar to those in acute pancreatitis, though there is less of acuteness in both. The term *subacute* applies more accurately to gangrenous and suppurative conditions than the word *acute*. But it will readily be understood that between the most virulent and the most lethargic cases there is an unbroken series. The onset in the subacute cases is not so abrupt, and the progress of the symptoms by no means so rapid. There is, indeed, the same kind of difference as exists between the acute and the subacute forms of perforating ulcer of the stomach.

Treatment.—An incision is made between the umbilicus and the ensiform cartilage. As a general rule, there will be a marked bulging of the epigastrium, or palpation will reveal the presence of a deep-seated tumour. The pancreas will be exposed, in the majority of cases, by tearing gently through the gastrohepatic omentum. It will then be obvious if one part rather than another of the pancreas is involved, and if a well-defined abscess cavity is located, it may be opened after adequate protection of the peritoneal cavity has been assured; or the abdomen may be closed, and a posterior incision in the left (or occasionally in the right) costovertebral angle may be made, so that an adequate escape is afforded to the pus, without risk of contamination of the peritoneum. In the majority of cases, however, drainage from the front will be necessary. Before the abscess cavity is opened, the peritoneum is walled off with gauze. The contents of the abscess are not fetid, and the pus on examination may be sterile. Very often little lumps of necrosed fat or portions of disintegrating pancreas may be found

in it, and in some instances large, greyish-black sloughs of the pancreas may be removed. The loss of even a large portion of the pancreas does not seem to lessen, at any rate perceptibly, the chances of recovery of the patient. I know of two patients who are living and in perfectly good health, whose metabolism seems perfectly satisfactory, in whom at least one-third of the pancreas was removed as a slough.

The sloughs that I have seen are always deeply stained with altered blood-pigment; they are grey or greyish-black in colour, and are clearly the result of a process exactly similar to that seen in acute hæmorrhagic pancreatitis. The formation of the slough is the end condition of which hæmorrhagic infiltration is the earliest recognisable manifestation. Mayo Robson mentions that, in all, 14 cases of abscess of the pancreas have been operated upon, with 5 deaths.

CHRONIC PANCREATITIS.

Though Riedel was the first to point out that a condition of chronic induration of the head of the pancreas was at times associated with cholelithiasis, especially with stone in the common duct, it is to Mayo Robson that we are indebted for a clear description of the clinical symptoms of the disease and for the first recognition of the fact that surgical treatment is capable of affording complete relief in the great majority of cases.

Chronic pancreatitis is generally due to gall-stone irritation, especially to the presence of a stone impacted in the ampulla of Vater or in the lower end of the common duct. Other causes are pancreatic calculi, obstructions of the duct by pressure from without, typhoid fever (as first described by me in the "Lancet"), alcohol, syphilis, gastric or duodenal ulcer, etc. The description which Opie has given of the two forms of chronic pancreatitis, interlobular and interacinar, has been generally accepted. In the former the interstitial deposit of fibrous tissue occurs in wide bands separating the lobules of the glands; in the latter there is newly formed fibrous

tissue within the lobules. In the former the contraction of the newly formed fibrous tissue causes an atrophy of the secretory portion of the gland, and the processes of digestion are, therefore, affected; in the latter the islands of Langerhans are also affected, are sometimes all the part that suffers, and consequently it is not only the digestive, but also, and chiefly, the metabolic, processes that are affected.

The **symptoms** of chronic pancreatitis are very similar to those found in cases of malignant disease of the head of the gland; indeed, there have been many cases—doubtless there are still many—in which an erroneous diagnosis of cancer has been made. It is to Mr. Mayo Robson that credit is chiefly due for the differentiation of the two diseases, a clinical advance of the first magnitude. Of chronic pancreatitis in its clinical aspects he writes:

"The symptoms of pancreatic catarrh passing on to interstitial pancreatitis present great varieties according to the cause; for instance, if it be due to gall-stones, there will be a history of painful attacks in the right hypochondrium, associated with jaundice and possibly accompanied by fever of an intermittent type. Tenderness at the epigastrium with some fulness above the umbilicus will usually be noticed; loss of flesh soon becomes marked, and if the pancreatic symptoms predominate, the pain will pass from the epigastrium around the left side or even to the renal and scapular regions. Fat and muscle-fibres may be noticed in the motions as soon as the obstruction to Wirsung's duct is complete, and the pancreatic reaction will be found in the urine. If gall-stones be not the cause, there may be merely an aching or painful attacks not at all pronounced, or the symptoms may come on painlessly, associated with dyspepsia and with slight jaundice, soon becoming more marked; in such cases the gall-bladder may dilate and give rise to a suspicion of cancer of the pancreas which the rapid loss of flesh will tend to confirm. In the later stages pale or white and bulky motions may be passed, and a hæmorrhagic tendency will be noticed. The liver is usually enlarged when the common bile-duct is tightly gripped, and in several cases I have found cirrhosis of the liver,

doubtless due to long-continued stagnation of septic bile in the ducts. I have seen well-marked enlargement of the spleen on four occasions. In one patient the fever and the enlarged spleen gave rise to a symptom of ague, the organisms of which were said to have been found in the blood."

The importance of the early recognition and treatment of chronic pancreatitis cannot be exaggerated, for the disease if left unchecked may produce such a sclerosis of the gland that the whole of the secretory substance and all the islands of Langerhans may be destroyed. The result is diabetes which proves fatal. Even when operative treatment is adopted, the condition may have progressed so far that nothing more can be done than to remove the cause of the disease and to prevent its increase, the damage already done to the gland being irreparable. In one case of my own where chronic inflammation of the whole of the gland was found, due almost certainly to a stone, long impacted in the ampulla of Vater, which had escaped by the formation of a fistula between the lower end of the common duct and the duodenum, there was relief from cholecystotomy followed by prolonged drainage, but the patient died after three and one-half years from diabetes.

Treatment.—The treatment of the disease will necessarily vary according to its cause. If a stone be found in the common duct or in the duct of the pancreas, it must be removed. If a gastric or duodenal ulcer be found, it must be treated by excision or gastro-enterostomy, as seems best. But the main indication to be fulfilled is drainage of the bile to the surface for such a length of time as will allow the ducts to free themselves from infection.

Drainage of the gall-bladder may be instituted either by the operation of *cholecystotomy* or by the operation of *cholecyst-enterostomy;* the former, for some reasons, is to be preferred. By it the bile is drained to the surface and the common duct is, therefore, empty. After the operation of cholecyst-enterostomy bile may flow into the intestine through the

new opening, but intestinal contents may also pass into the gall-bladder and increase the infection which it was the purpose of the operation to relieve. When cholecystenterostomy is performed in the manner already described, with a simultaneous lateral anastomosis or exclusion of the intestine, the risk of this infection is lessened considerably but is not abolished.

The disadvantage of cholecystotomy is that it does not afford a sufficiently prolonged drainage; the operation of cholecystenterostomy is therefore from this point of view decidedly to be preferred.

The operation of choice in chronic pancreatitis consists, therefore, in the removal of the cause and in the institution of drainage for the bile, by the performance of cholecystotomy, cholecystenterostomy or by direct drainage of the hepatic duct by choledochotomy. The results of these operations are most satisfactory if treatment is not too long delayed. A perfect recovery may be expected in the very great majority of cases. But if long-standing infection is discovered, the damage already inflicted upon the liver, the ducts, and the pancreas may be irreparable, and cirrhosis of the liver or sclerosing pancreatitis may remain, and may, in the end, prove fatal.

The mortality of the operation, judging by all recorded cases, is about 10 to 12 per cent.; but many of the patients were desperately, almost hopelessly, ill. A mortality not exceeding about 5 per cent. is what may be reasonably expected in the future.

CHAPTER XLV.

PANCREATIC CYSTS.

THE term "pancreatic cyst" has been used to describe any fluid tumour in, or associated with, the pancreas, though such tumours differ widely in causation, position, and clinical features.

The following classification is as precise as our present knowledge permits:

1. Retention cysts.
2. Proliferation cysts { Cystic adenoma. / Cystic carcinoma.
3. Hydatid cysts.
4. Congenital cystic disease.
5. Hæmorrhagic cysts.
6. Pseudocysts.

From the pathological standpoint the inclusion of the last form is not permissible. As, however, the clinical features tally precisely with those of true pancreatic cysts, the academic objection must give way to considerations of convenience.

1. **Retention Cysts.**—Virchow ("Die krankhaften Geschwülste," 1863, vol. i, p. 276) described two forms of retention cyst of the pancreas. In the one the whole duct is widened, and a "rosary-like" dilatation occurs. In the other the duct is blocked at its outlet and becomes distended into a cyst, which may reach the size of a fist and may contain mucoid, hæmorrhagic, or calculous matter. With the smaller cysts there can generally be little or no difficulty in determining their origin; with the larger cysts,- with such as the surgeon is destined to meet,—the differentiation may be difficult or impossible. Virchow himself has expressed his inability to determine the origin of

a large cyst attached, on the one side, to the pancreas, and, on the other, to the stomach.

The causes of retention cysts are:

(*a*) The impaction of a calculus or calculi.

(*b*) Cicatricial stenosis.

(*c*) Pressure upon the duct from without.

(*d*) Dislocation of a part of the gland.

Retention cysts have been recognised as such during the course of the operation by several observers. In Ludolph's case ("Inaug. Dissert.," Bonn, 1890) the cyst was excised and the opening of the duct clearly seen. Hagenbach found two dilated radicles of the main canal opening into the cyst. Dixon ("Medical Record," March, 1884) found the duct opening into the larger of two cysts. Richardson's case was considered by him to be a cystic dilatation of the duct. As it is rarely possible to make an exhaustive inspection of the parts during an operation, it is perhaps remarkable that so many observations have been recorded.

On the postmortem table specimens have been recognised by Virchow, Klebs, Gould, and many others. Virchow applied the term "ranula pancreatica" to a general distension of the whole duct. When numerous small engorgements of the minute ducts are present, Klebs suggested the name "acne pancreatica."

2. **Proliferation Cysts.**—Proliferation cysts may be either simple or malignant. The exact differentiation is not infrequently difficult, and is at times impossible, from the pathological standpoint. One has, in some cases, to await the course of events after the removal of a cystic tumour before deciding as to the class in which to include it. Thus Fitz, of Boston, in relating his case ("Amer. Jour. of Med. Sci.," August, 1900), says: "The tumour, from its histological appearances, is to be regarded as essentially a multilocular cystoma, but on the border-line between a proliferating cystoma or cystadenoma and a cystomatous carcinoma, a distinction which the subsequent history of the patient may be expected to make clear."

3. **Hydatid Cysts.**—Hydatid cysts of the pancreas are extremely rare. Massèron ("Thèse de Paris," 1881) was able to collect the records of only five cases, and these were first recognised on the postmortem table. Graham, of Sydney ("Hydatid Disease in its Clinical Aspects," 1891), writes: "The hydatid is sometimes found in the pancreas. I have observed it as a cyst about three inches in diameter, replacing the head of the organ." Tricomi states, without giving references, that seven cases have been recorded.

4. **Congenital cystic disease,** similar to the congenital cystic disease of the liver and kidneys, has been observed on rare occasions. Dr. Pye-Smith recorded ("Path. Soc. Trans.," 1885, p. 17) a case of cyst of the cerebellum with numerous small cysts in the pancreas and kidneys. The patient was a man aged twenty-seven.

Richardson has recorded a cyst of the pancreas occurring in a child fourteen months old; and in one case, related by Shattuck, a tumour had been noticed since birth.

5. **Hæmorrhagic Cysts.** That bleeding may occur into the substance of the pancreas as the outcome of acute or chronic inflammation is well proved.

Of the influence of these or other hæmorrhages, traumatic or spontaneous, upon the building up of a cyst, no positive opinion can be expressed. Hagenbach distinguishes between hæmatoma, in which bleeding occurs into pre-existing cysts, and apoplectic cysts, resulting from hæmorrhage into softened, degenerate gland substance. In favour of the hæmorrhagic origin of cysts are the writings of Kühnast, Schröder, and Friedreich.

Gussenbauer conjectured that the origin of the cyst in the case operated upon by him was due to a central hæmatoma of the pancreas. In discussing the case Senn remarks: "This assumption lacks demonstration, and it is just as logical to assume that the cyst originated in the usual way from an obstruction, and that the blood in the cyst contents was an accidental product," a comment with which Körte seems in accord.

6. **Pseudocysts.**—Körte has proposed the term "pseudocysts" for those fluid tumours found in more or less close proximity to the pancreas, but not originating in the substance of the gland. The accurate distinction of a true pancreatic cyst from a pseudocyst is not always possible during life, for a cyst primarily peripancreatic may originate in a trauma which implicates the gland at the same time, so that the pancreatic juice may in small quantity escape into the pseudocyst and make its mimicry of a true cyst so complete that a distinction is impossible. I am, indeed, strongly inclined to believe that many cases of so-called pancreatic cysts, especially those of traumatic origin, are in reality peripancreatic or pseudocysts, effusions into the lesser cavity of the peritoneum, localised extravasations of blood, and so forth. In some recorded examples the origin of a cyst in the pancreas is purely hypothetical, and in these the tumour may be a "pseudocyst" of the pancreas or a true cyst of a neighbouring organ, such as the suprarenal or the kidney.

The most frequently occurring form of "pseudocyst" is that first described by Mr. Jordan Lloyd ("Brit. Med. Jour.," November, 1892). In this very important paper attention is drawn to effusions into the lesser peritoneal cavity, as the result of injury to the pancreas, and two cases are fully reported.

Mr. Jordan Lloyd writes: "The diagnosis of pancreatic cyst appears to me often to have been made upon insufficient evidence. The fact that a cavity within the abdomen contains pancreatic secretion is no proof whatever that the cavity is within the pancreas; it tells us nothing more than that the cavity is connected with this organ. Neither is the fact that the pancreas can be felt by an examining finger from within an intra-abdominal sac, for if the lesser peritoneal cavity is opened from below by an incision in the transverse mesocolon, a finger passed through this opening enters a large space, at the back of which the pancreas is found; similarly, too, if the lesser peritoneal cavity is opened by an incision in the great

omentum below the stomach. Through either opening the deepest part of this space is found to the left, and cannot be reached by the examining finger."

Mr. Jordan Lloyd summarises his conclusions as follows:

"1. That contusions of the upper part of the abdomen may be followed by the development of a tumour in the epigastric, umbilical, and left hypochondriac regions.

"2. That such tumours may be due to fluid accumulations in the lesser peritoneal cavity.

"3. That when the contents of such tumours are found to have the property of rapidly converting starch into sugar, we may assume that the pancreas has been injured.

"4. That many such tumours have been regarded as true retention 'cysts of the pancreas,' and that this opinion has been formed upon insufficient evidence.

"5. That the diagnosis of distension of the lesser peritoneal cavity before operation can usually be made by the characteristic shape of the swelling.

"6. That early median abdominal incision and drainage is the safe and proper treatment."

The following most interesting case is recorded by McPhedran ("Brit. Med. Jour.," 1897, vol. i, p. 1400):

G. A. B., male, fifty-three. In 1891 had an attack of biliary colic, with well-marked jaundice and pale motions. Had two or three similar attacks every year. Condition became gradually worse; there was almost constantly some epigastric discomfort, indigestion, flatulence. One severe attack of pain lasted three days; the epigastrium was tender, and pain radiated in several directions. Was losing flesh. On examination on a certain date there was an increase in the thickening in the deep part of the epigastrium; three days later a large, smooth, cyst-like tumour was found in the epigastrium, extending from the right parasternal line to the left mammary line and down to the umbilicus. The upper boundary was ill defined; the stomach resonance was above and to the left. A cystic collection in the bursa omentalis was diagnosed, and the abdomen was opened. The cyst was emptied; at the bottom lay the

pancreas, irregularly enlarged and firm, but somewhat elastic. The peritoneum over it was smooth and healthy looking. There was no sign of hæmorrhage anywhere. Five months after a tumour was again found in the epigastrium; this tumour extended down to the level of the anterior superior spinous processes and laterally to the mammary line on the right and the anterior axillary line on the left. It forced the diaphragm upwards, so that the cardiac impulse was in the fourth intercostal space. The abdomen was again opened, and a cyst exposed lying behind the stomach; the cyst-wall was about 2 mm. thick; the fluid was opaque, whitish, and contained many flocculi and fibrin masses. The fluid was alkaline, contained albumin and no digestive ferment. The cavity contracted rapidly, but a fistula persisted. The discharge from this irritated the skin. On examination it was found to possess marked action on albuminoids, fats, and starches, leaving no doubt as to the presence of pancreatic secretion. The condition causing the repeated attacks of colic lay in the pancreas, and may have been a calculus or a localised inflammatory deposit causing mechanical obstruction. In the most acute attack the symptoms were those of acute pancreatitis.

This case is especially interesting from the fact that it is, so far as I know, the only one recorded in which a pseudocyst and a true cyst have been observed in the same individual.

PATHOLOGICAL ANATOMY.

Cysts of the pancreas are rather more frequent in men than in women. Of 121 cases collected by Körte, 60 were males, 56 females; in the remaining 5 no mention of sex is made.

The youngest patient affected was a child thirteen months old, whose case is recorded by Shattock. Richardson has operated upon a child fourteen months old. Stiéda's patient was a man of seventy-six.

The cystic tumour may be situated at any part of the gland from the duodenal margin of the head to the tip of the tail. The body is more commonly affected than the head, and the

tendency to implication seems, roughly, to increase as the tail is approached.

In 22 cases collected by Hagenbach the cyst arose in the tail 10 times, 4 times in the head, once in the body, and in 7 the site is not indicated. Nimier gives the following: 21 times in the tail, 6 times on the body, 4 times in the head, once in the head and the body, and in 1 the whole organ was implicated.

Cysts may be single or multiple, unilocular or multilocular. Two cysts may be simultaneously observed of almost equal size; or, after the healing of one cyst, a second may develop in a distant portion of the gland and necessitate further operation. One small cyst may be found with a large number of smaller ones packed in its walls.

The cysts are generally smooth and rounded; they are elastic and rather tense. The inner surface of the cyst-wall is commonly smooth, and lined throughout by cylindrical epithelium; trabeculæ or incomplete septa may at times be present, and a thimbling of the surface may be seen. Intracystic polypoid masses are found in cases of proliferation cyst. In the great majority of recorded cases blood in greater or less quantity has been observed.

SYMPTOMS AND SIGNS OF PANCREATIC CYSTS.

The symptoms produced by a pancreatic cyst are chiefly referable to the pressure exerted by the tumour upon surrounding viscera. In the earlier stages, while yet the tumour is small, the symptoms are absent, or so trivial as to attract but little attention. Almost imperceptibly the feelings of discomfort, weight, and fulness in the epigastrium increase. Pain is noticed towards the end of, and for some time after, a meal, and vomiting becomes gradually established as a distressing symptom. To these earlier, less pronounced, symptoms Friedreich has given the name "cœliac neuralgia." The pain is generally confined to the upper half of the abdomen, but it may radiate to the back, especially on the left side, and has been said

to strike downwards into the testes. The intensity of the pain is liable to wide variation: it may resemble that of "indigestion," or may be acute and almost intolerable, and suggest intestinal obstruction. Vomiting is inconstant and variable, but generally in close relationship to the amount of pain suffered. In one case related by Kocher pain and vomiting occurred in paroxysmal outbursts every two or three months. Salivation is rarely noticed; the vomiting of clear, colourless fluid, "salivatio-panereatica," is recorded by Zielstorff.

The functions of the bowels are generally sluggish; obstipation is the rule, but may give place to diarrhœa at times; a blood-stained liquid motion has been occasionally remarked. In one case, recorded by Indemans, a bloody diarrhœa constantly recurred.

Jaundice is noticed in a small proportion of cases. It depends upon a pressure exerted by the tumour upon the common duct, and is therefore associated almost always with a tumour in the head or neck of the pancreas. Körte finds the occurrence of jaundice noted in 9 out of 121 cases.

In these few recorded examples of giant cyst the usual concomitant disabilities of a largely distended abdomen are noticed. Dyspnœa is mentioned by Zielstorff, Filipoff, Stapper, and Shattuck.

In almost every case the general health of the patient suffers seriously. Wasting is rapid and continuous. In one of my cases the patient lost three stones of weight in seven weeks. Weakness is very pronounced, and in appearance the patient ages quickly, looking sallow, pinched, shrunken, and profoundly ill. According to Friedreich, wasting is more serious when affections of the bile-passages are associated with disease of the pancreas.

The cystic tumour developing in the pancreas lies behind the posterior layer of peritoneum, forming the lesser sac. As the swelling increases it bulges into the lesser sac and is covered, whatever direction it may take, by this layer of the serous

membrane. The tumour is at first placed behind the stomach, but in its gradual enlargement it displaces the viscus. It may pass in one of three directions:

(*a*) In the great majority of cases the stomach is pushed upwards and to the right, and the transverse colon is pushed downwards, the cyst coming to the surface below the greater



Fig. 202.—Cyst of the pancreas; the cyst presents above the stomach.



Fig. 203.—Cyst of the pancreas. The stomach and the transverse colon lie in front of the cyst.

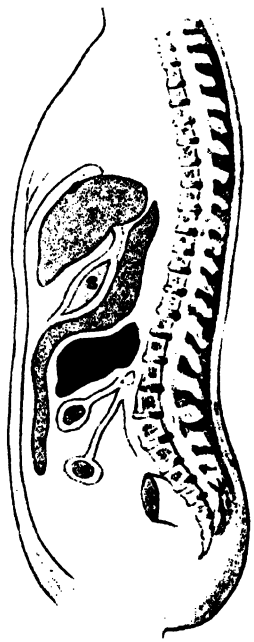


Fig. 204.—Cyst of the pancreas. The cyst presents between the stomach and the colon.

curvature of the stomach. In order to reach the cyst through the abdominal wall the parietal peritoneum, the two layers of peritoneum forming the great omentum, and the posterior layer of peritoneum of the lesser sac, have all to be divided. The amount of pressure and displacement to which the stomach and the transverse colon are subject depends entirely upon the bulk of the cyst. The stomach may be jammed tightly under

the liver, and the transverse colon may, as recorded by von Riedel, Salzer, Heinricius, and others, be pushed down as low as the symphysis pubis.

(*b*) In certain cases the enlarging tumour may push its way forwards above the upper border of the stomach and there present. In order to reach the cyst in this position the following layers of peritoneum must be divided: parietal, two layers of

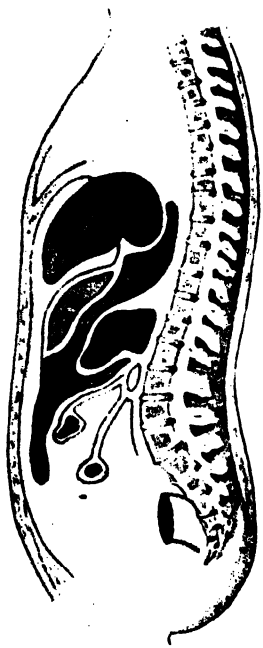


Fig. 295.—Cyst of the pancreas. The stomach lies in front of the cyst: the transverse colon is below it.

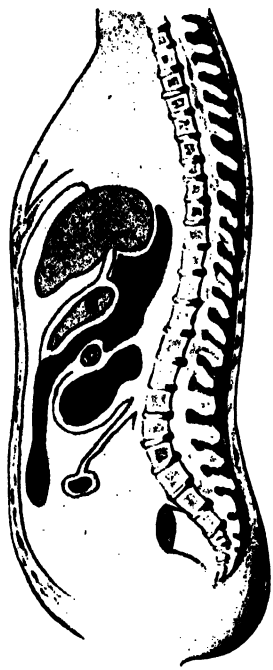


Fig. 296.—Cyst of the pancreas. The cyst lies below both the stomach and the transverse colon.

the gastrohepatic omentum, posterior layer of the peritoneum of the lesser sac. The stomach is pushed downwards, and the liver forced upwards and to the right. The most prominent part of the cyst presses against the anterior abdominal wall. In one case Albert saw a bulging of the cyst through the foramen of Winslow into the greater cavity of the peritoneum. The presenting of the cyst above the lesser curvature of the

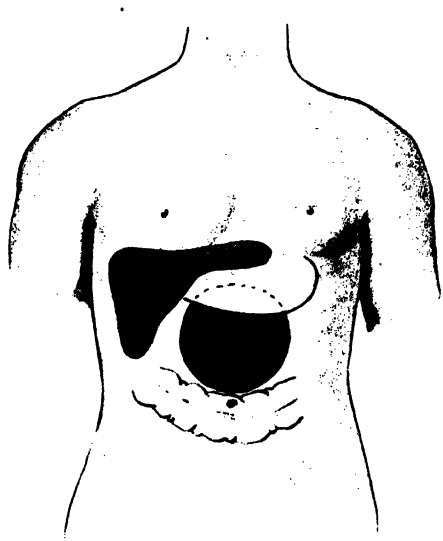


Fig. 297.—Cyst (or tumour) of the pancreas. The cyst presents between the stomach and the transverse colon.

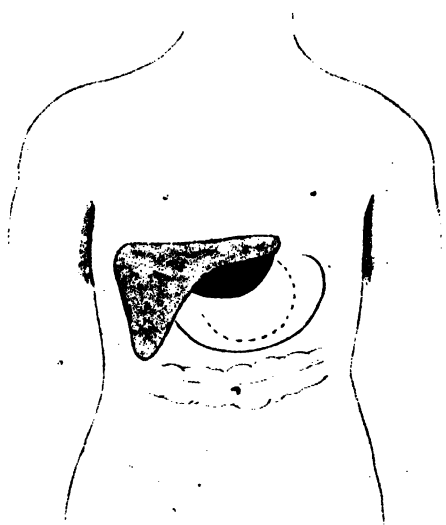


Fig 298.—Cyst of the pancreas. The cyst projects forwards between the liver and the stomach.

stomach has been observed in eleven cases (Albert, Indemans, Zielstorff, Riegner, Swain, Hahn, Karewski, Doran, Herman, Finotti). Riegner and Finotti diagnosed the position before operation.

(*c*) If the cyst spring from the lower portion of the head of the pancreas or from the inferior border of the body or tail, it will be at the lower limit of the lesser sac. As it then increases in size it will push its way between the layers of the transverse mesocolon, or bulge downwards the inferior layer. If

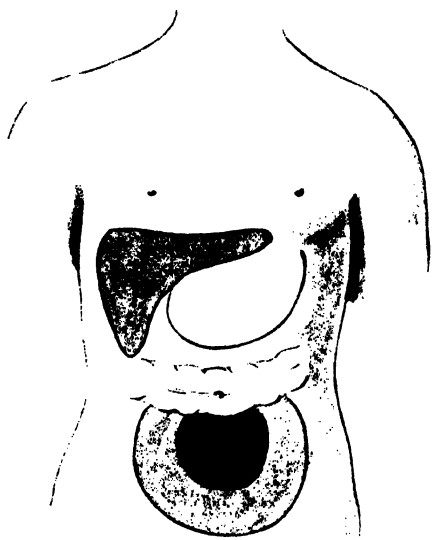


Fig. 299.—Cyst of the pancreas. The cyst presents below the transverse colon. The darker area is the area of absolute dulness. The surrounding area represents the region of partial dulness.

the former, the transverse colon will run directly across the front of the cyst; if the latter, the transverse colon and the stomach will both be pressed upwards.

Cases in which the transverse mesocolon was invaded are recorded by Zukowski, von Petrykowski, Lardy, Salzer, Riegel, Treves. The tumour then presents as a smooth, rounded mass, crossed at or near its middle by the stretched colon.

The bulging of the lower layer of the transverse mesocolon

is recorded by Hersche, Lindh, and Heinricius. The great omentum may be stretched over the cyst, and thinned by its enlargement, or it may be pushed aside. If the former, the parietal peritoneum, the great omentum, and the inferior layer of the transverse mesocolon have to be cut to reach the cyst, and in the latter the parietal peritoneum and the inferior layer of the transverse mesocolon only. In one instance, recorded by Bernard Pitts and Shattock, the enteric mesentery invested the front of the cyst. Martin found the descending colon in front of the cyst in his case, and Schwartz, the cæcum; in both the tumour was of large size and occupied the larger part of the abdomen.

DIAGNOSIS.

The signs and symptoms warranting a diagnosis of pancreatic cyst are as follows: A patient ill, with indefinite symptoms of epigastric uneasiness, weight, pain, and occasional vomiting, begins to lose weight, and, on examination, a swelling of the upper part of the abdomen is discovered; or, a patient suffers an injury of some severity to the upper part of the abdomen,—the kick of a horse, a heavy blow, or while lying on the ground the abdomen is trampled upon,—within a brief period of days or weeks a tumour forms, with or without symptoms, in the epigastric region. As the tumour enlarges the symptoms become more acute, or, less commonly, remain stationary. Jaundice, intestinal hæmorrhages, or diarrhœa may be observed.

The tumour which forms lies generally in the epigastric region, with its most prominent aspect at or near the middle line or between the midline and the left costal margin. The tumour is rounded, generally smooth, elastic, or fluctuating. It may vary in size from time to time. It is dull on percussion in the centre, but above percussion demonstrates the stomach resonance, and below, that due to the transverse colon. Inflation of these viscera, as first suggested by Gussenbauer, increases the area of their tympany and lessens the central dull

area of the tumour. The tumour is fixed; the skin over it, smooth and unwrinkled.

In the urine sugar may be found; in the fæces, an excess of fat and of undigested muscle-fibre.

TREATMENT.

The operative treatment of pancreatic cysts is limited to three methods:

1. Aspiration.

2. Evacuation and drainage, the cyst being stitched to the abdominal wall (Gussenbauer's method).

3. Extirpation, partial or complete.

1. Aspiration.—This method may be dismissed in a few words. It is unscientific, unsatisfactory, and redolent of mediævalism. The risks and drawbacks of this old-time procedure need no emphasis to-day. All surgeons feel that it is not the simple procedure that was at one time supposed. In the days before antiseptic surgery was introduced almost any risk was run rather than that the certainty of disaster which followed an open incision should be encountered. With modern methods, however, there can be no hesitation in saying that the open operation does not possess a tithe of the risk of this blind procedure. The method of aspiration is not only dangerous: it is futile. It has never been attended with success. In Lynn's case ("Lancet," 1894) it is practically certain that the tumour was due to a fluid effusion into the lesser sac, with perhaps a rupture of the pancreas as well. In fact, all our knowledge of pancreatic cyst disproves the possibility of cure by aspiration, however often repeated.

If the cyst be emptied, it will refill. The risks during refilling are leakage from the point of puncture and laceration of the cyst starting from the small opening, both of which have been recorded.

If the patient is seriously ill from diabetes or suffering acutely from pressure symptoms, and unable to withstand the shock

of an abdominal operation, an aspiration may be resorted to in the hope of tiding the patient over an acute crisis, so that the subsequent operation may safely be borne. Under no other conditions can it be considered desirable.

2. Evacuation and Drainage.—The method which has been the most frequently adopted is that of stitching the cyst to the abdominal wall, and opening and draining its cavity. The operation may be done in one or two stages, the opening of the cyst being delayed until adhesions have formed which protect the peritoneal cavity. The operation at two sittings has rarely been adopted in recent years. Of seventeen cases collected by Takayasu, death occurred in one.

The abdomen is opened by a median or slightly lateral incision. As a rule, the cyst will be found to bulge forwards below the greater curvature of the stomach and above the transverse colon. The cyst is exposed by tearing gently through the omentum just below the greater curvature of the stomach. A careful exploration and examination are made in order to determine the source of the cyst, the condition of the pancreas, the presence of adhesions, and so forth. The most prominent part of the cyst being exposed, a few swabs are packed around, to prevent any leakage into the peritoneal cavity or any soiling of the abdominal wall. An aspirator needle is then thrust into the cyst and the contents are evacuated. As the needle is withdrawn a clip is placed over the puncture. By gentle traction on the clip the cyst can be lifted well up into the wound. With a curved intestinal needle threaded with strong catgut, fine silk, or Pagenstecher thread, a continuous suture unites the peritoneum, covering the cyst to the parietal peritoneum. When the stitching is secure, the clip may be removed, the puncture which it guarded enlarged into an opening, and a large rubber drain introduced.

Drainage may be secured by an opening through the loin, as advised by Cotterell and Pearce Gould. This should be done after the exposure of the cyst and its evacuation through an

abdominal incision. In cases where the diagnosis is difficult this method permits of a certain diagnosis. After the emptying of the cyst a finger is passed to the back of the cavity, and by pressure is made to present below the last rib, where an incision is made down on to it and a drainage-tube is introduced. The anterior wound in such a case must also be drained, the cyst-wall being stitched to the parietal peritoneum. The anterior wound gives vent to very little fluid and heals rapidly.

In some cases, deliberately or after a mistaken diagnosis, an incision has been made posteriorly and the cyst contents have been at once evacuated.

Peters, in a case of hydatid cyst of the tail of the pancreas, made no abdominal incision, but cut directly down from the loin through an incision three inches in length, made from the margin of the erector spinæ forward, about parallel to the last rib, and curving slightly upwards around its end in the direction of the margin of the costal cartilages. The lumbar fascia was divided, the colon reached by pressing the finger upwards, forwards, and inwards.

The exposure of the cyst from the front is not seldom a matter of difficulty; adhesions may be numerous and dense, and the vessels in the omentum may be greatly enlarged, swollen, and easily lacerable. As bloodless a spot as possible must be found in the great omentum, and as few vessels interfered with as is consistent with adequate exposure of the cyst-wall. Any vessels needing division should be doubly ligated before being severed.

Hagen ("Archiv f. klin. Chir.," Bd. lxii, H. 1) reports a case of abdominal tumour in a boy thirteen years of age. Laparotomy was performed, and after opening the abdomen a cyst, about the size of a child's head, was found, posterior to the stomach, firmly surrounded by adhesions, so that it was impossible to bring the cyst-wall in contact with the abdominal wall, and equally impossible to remove the cyst as a whole. The only hope of saving the child's life, however, was in the evacua-

tion of the cyst. Approach to the cyst was finally gained by first incising the anterior gastric wall, and then, through the cavity of the stomach, the posterior gastric wall was reached and the cyst opened. The contents of the cyst were easily removed. A finger passed in through the openings found the least external resistance on the left side of the cyst, and with difficulty the stomach was here displaced a little towards the right, so that, pushing firmly on the abdominal wall, the cyst could be brought in contact with the parietal peritoneum. The two wounds in the stomach were sutured—first that in the posterior wall and afterwards that in the anterior wall. In order to allow the abdominal wall to fall in to a sufficient extent to come in contact with the cyst it was found necessary to resect a part of the ninth and tenth rib cartilages. The cyst was then sutured to the abdominal wall and opened. Examination of the cyst shewed that it was evidently the result of a chronic interstitial inflammation of the pancreas. The patient stood the operation well, and two months afterwards the cyst had disappeared, the pancreatic fistula had closed, and the patient had gained twenty pounds in weight.

If the cyst is not of a large size, there may be some difficulty in dragging its wall up to the parietal peritoneum in order to suture it there. Under these circumstances a tube surrounded by gauze may be passed down to the cyst, the tube projecting beyond the gauze into the cavity; or a purse-string suture may be passed around the opening into the cyst and a tube introduced. On tying the suture the tube is held firmly in position, and will so remain until lymph has been thrown around it to wall off the general peritoneum; or, again, a fold of the great omentum may be brought round to form a barrier to the escape of fluid into the peritoneal cavity. If none of these devices seems desirable, then, after exposure of the cyst and its evacuation by means of an aspirator needle, gauze packing may be introduced and left for three days. On removing it, it will generally be found that a water-tight channel from the abdominal

wound to the cyst has been formed, and that the cyst may then be safely opened without the risk of peritoneal contamination. When the cyst is very tense and cannot be made to reach the abdominal wall, the contents should be removed by aspiration. The flaccid walls can then be drawn well forwards, and suture to the parietal peritoneum is quite easy.

The mortality of this method has been carefully computed from the records of published cases by Körte.

From Gussenbauer's case, the first one so treated, there have been 84 patients submitted to operation. Of these, 1 died of sepsis (Ogston), 2 died of peritonitis (Durante, P. Gould), and 1 died of shock and peritonitis (Mérigot de Treigny). Two patients who suffered from diabetes subsequently died (Churton and Pagenstecher); 2 patients who were operated upon for cystic epithelioma died soon after operation (Labbee and Hartmann); and 1 (Reeve) died of secondary infection from the fistula. This last case and the first four may be considered as deaths from the operation—5 deaths in 84 patients, a comparatively small mortality. Takayasu, in a tabular list of 64 cases, found 8 which proved fatal.

The sinus which remains after this operation may discharge fluid for many weeks or even months. The fluid is often very irritating, digesting the skin and making it red, intensely sore, and angry. It is, therefore, better to keep a fine tube in as long as possible, the outer end of the rubber tube leading into a test-tube or a little rubber bag fastened to the patient's clothing. The fluid is clear and watery, and gives all the reactions characteristic of pancreatic secretion.

3. Extirpation.—The extirpation of a pancreatic cyst is seldom necessary, and is rarely capable of successful accomplishment. The adhesions formed by the tumour are often of the densest character; blood-vessels of large size run in and around the cyst-wall, and the tissues are very readily lacerable. An attempt at extirpation under such conditions is very hazardous and may prove impossible. Mikulicz, than whom there

are few surgeons more dexterous, on two occasions has abandoned attempts at removal, finding the physical difficulties insuperable. In 2 cases (Billroth, Mikulicz) the splenic vessels have had to be tied in liberating the cyst from adhesions.

If, as may rarely be the case, the cyst is rather narrowly pedunculated and the adhesions are of no great density, then extirpation may properly be attempted. In all, 15 cases of complete excision have been recorded, with 13 recoveries. In 7 additional cases the extirpation has been only partial, some of the cyst-wall being irremovable; 4 of these patients died.

The pedicle has been ligated (Clutton and others), clamped with forceps (Poncet), or divided with the thermocautery (Kosinski). In almost all the cases the cyst presented between the stomach and omentum. The most favourable case for excision was that related by Sharkey and Clutton. The patient was a female, aged thirty-five, who had noticed an abdominal enlargement for sixteen or twenty years. The tumour was remarkably movable in all directions. At the operation the tumour "shot out of the wound with the greatest facility," with the tail of the pancreas attached to it. The splenic artery and vein had to be dissected off the tumour, which was removed entire, without being opened. The pedicle bled freely and was packed with gauze. The wound for some time after the operation discharged pancreatic juice. The contents of the cyst were fluid, canary yellow in colour, of specific gravity 1024; albumin was present in large quantity; the fluid was turbid and iridescent with cholesterin.

CHAPTER XLVI.

NEOPLASMS OF THE PANCREAS.

Carcinoma of the Pancreas.—The most common of the new-growths of the pancreas is carcinoma. The growth may be primary or secondary; far more commonly the latter. It is, of course, to be remembered that in the statistics of all hospitals the term "carcinoma" probably includes many cases of chronic simple induration of the head of the pancreas, for until the last few years there was no accurate discrimination, clinically, between the two diseases. The great frequency of secondary growths as compared with primary is due to the fact that the gland is not infrequently implicated in the extension from gastric carcinomata. The growth may involve any part of the pancreas, but is found most frequently in the head.

Oser, in 78 cases, found the distribution of the growth to be: in the head, 39 times; in the whole organ, 19 times; in the tail, 4 times; in the head and body, 3 times; in the body and tail, once; in the body, once; in the head and tail, once. The fact that the duodenal end of the duct is so commonly affected accounts for the character of the symptoms usually observed. For the growth then compresses the common bile-duct and the canal of Wirsung, and leads to a gradual dilatation of both. As a result of the retention of the secretion of the pancreas and a consecutive diminution in its quantity there are symptoms due to an insufficient digestion of food, such as marked and rapid progressive wasting, azotorrhœa, and steatorrhœa. Boldt has shewn that in one case in three of malignant disease affecting the head of the pancreas a dilatation of the duct of the gland is seen.

As a result of the compression of the common bile-duct there is jaundice, and in the majority of cases, in conformity with

Courvoisier's law, there is a distension of the gall-bladder with bile. The jaundice comes on slowly and imperceptibly at first. As a rule, the alteration in colour is commented upon by a relative or friend before the patient notices it. The jaundice, moreover, is progressive and not liable to variations. There is no fever, and pain is conspicuous by its absence. Before the appearance of jaundice the patient may feel weak, enfeebled, disinclined for exertion, and wasting is even then a matter of comment.

Sarcoma of the pancreas is very rare as a primary disease; secondary growths, especially in melanotic sarcoma, are not so rare. In some cases, as, for example, in those recorded by



ig. 300.—Tumour of the pancreas—cystic adenoma (after Lancereaux).

Michelsohn and Baudach, a combination of sarcoma with carcinoma—"sarcocarcinoma"—was found.

Adenoma of the pancreas has been noticed by Thierfelder, Biondi, and others. Thierfelder's specimen was found as a distinctly encapsulated tumour which could be easily enucleated. Biondi excised a "fibro-adenoma" from the head of the pancreas; the patient was alive and in good health two years later

TREATMENT.

The treatment of malignant disease of the pancreas by the surgeon can hardly be said to exist. It is true that recently

Franke ("Archiv f. klin. Chir.," Bd. lxiv, 1901) has related three cases in which malignant tumours of the gland were removed, but two of the patients died as a result of the operation, and in the third case the patient lived only five months. In this last case it is said that the whole pancreas does not convince one that this was done. I have elsewhere collected the records of all cases operated upon—thirteen in number. They all



Fig. 301.—Outer surface of tumour (Malcolm's case, Royal College of Surgeons' Museum, 2836 a).

serve to shew that the mechanical difficulties of the operation are well-nigh insuperable, and that if boldness and good fortune are the operator's gifts, the result to the patient hardly justifies the means.

I cannot do better than quote here in full a case related by Mr. Malcolm in the "Lancet," March, 1902:

"The patient was a female child and was born on March 9, 1894. Her father and mother are both alive and well; they

have one other child, a healthy girl, born in 1897. One of the patient's grandfathers was said to have died from an internal cancer at the age of sixty-five years. The patient had whooping-cough when she was three weeks old. It was not known that she had suffered from any lung trouble. The bowels were very constipated while she was under immediate observation. There was no albumin in the urine, which was scanty (sometimes only 12 ounces in twenty-four hours), and deposited urates, its specific gravity being usually about 1030. An abdominal swelling was first noticed in April, 1898, and Dr. R. L. Guthrie sent the patient to a well-known surgeon, who diagnosed a tumour

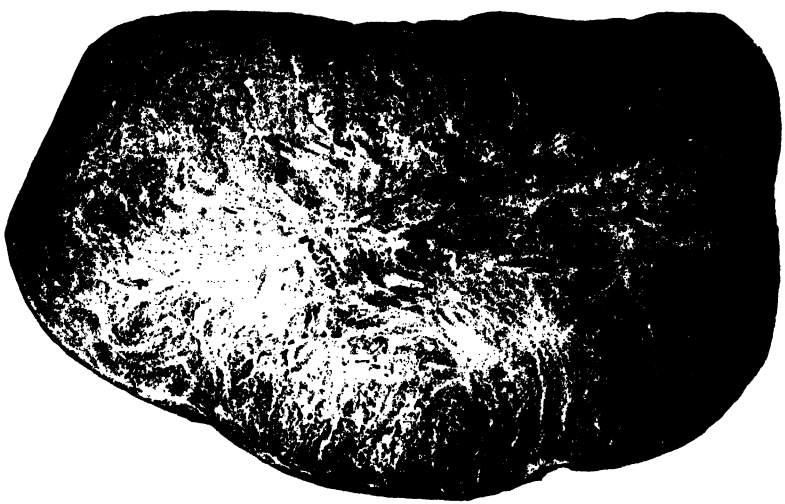


Fig. 302.—Cut surface of tumour.

of the left kidney, but advised that no operation should be performed. Dr. Guthrie asked me to see the patient in May of the same year. She had then an obvious swelling in the upper part of the left side of the abdomen. It was firmly held in the position of a renal tumour, but the attachments seemed sufficiently lax to allow of the growth being shelled out of its bed. The patient was, however, extremely emaciated and anæmic, having a cachectic appearance which seemed to contraindicate surgical interference, and I therefore agreed with the opinion and advice already given.

"Dr. Guthrie treated the child with iron and laxatives, and in October, 1898, he asked me to see her again. She then had

improved very much in her general condition, had quite a good colour, and was not thinner. The tumour had increased in size, but not to any great extent. It distended the hollow of the left loin, pushing the lower ribs upwards and forwards, bulging the side outwards, extending across the abdomen as far as the outer edge of the right rectus muscle, and downwards to below the level of the anterior superior iliac spines. The greatest girth of the body was 23¾ inches a little above the level of the umbilicus. On palpation the mass was smooth and elastic. It could be grasped between a hand in front of the abdomen and the other hand behind the loin, and although it was firmly held, there was still a slight mobility of the tumour, sufficient to make me think that I could remove it. There were some easily felt glands in both axillæ and in both groins, but they were not enlarged. The veins over the upper part of the abdomen were distended. No disease of the heart or lungs was detected. In view of the greatly improved condition of the child's general health I told the parents that she had a tumour of the kidney and explained that an operation would involve extreme risks. I also told them that I knew of only three cases in which, after the successful removal of a tumour of this kind from a child, the patient had survived more than a few months. On the other hand, I pointed out that death must occur soon if nothing were done. It was decided to accept the risks of an operation.

"On November 4, 1898, chloroform was administered and the tumour then seemed decidedly more mobile. I opened the abdomen through the upper part of the left linea semilunaris, and exposed the growth, with the splenic flexure and adjacent portions of the colon fixed in front of it. The most convenient place to open the retroperitoneal space, in which the tumour lay, was above the transverse colon, and when the peritoneum in that situation was divided, I had no difficulty in separating the tumour from the connective tissue in which it was loosely embedded. Some firm adhesions to the lower end of the spleen were separated, and the new-growth was then easily drawn out of the abdominal cavity, the tail of the pancreas being dragged out with it. The tumour was then only attached to the pancreas, and it was impossible to separate them without cutting through pancreatic tissue. In doing this large vessels were divided, but hæmorrhage from them was easily controlled by

ligatures. No ureter was seen during the operation. There was a second new-growth, of about the size of a bantam's egg, to the right of the cavity from which the tumour had been removed. I thought that this was a collection of glands affected by malignant disease, but the patient was in such a serious state of collapse that it was out of the question to attempt an investigation of the nature and connexions of this second abnormal condition. I therefore ligated all bleeding points, having



Fig. 303.—Shewing portal vein distended with growth.

much trouble in securing those on the spleen. I washed out the abdominal cavity with warm sterilised salt and water, leaving as much as possible inside, when the wound was sewn up, with a view to counteracting the shock of the operation, which, however, was not survived by the patient.

"At the necropsy, which was conducted by Dr. Cuthbert H. J. Lockyer, caseating glands were found near the bifurcation of the bronchi and in the anterior mediastinum. There were

extensive old pleuritic adhesions on the right side. There was no sign of peritonitis or of union of the lips of the wound. The peritoneal cavity was full of fluid (the salt and water introduced at the operation), which at first flowed away clear, but that from the loin pouches was deeply blood-stained. The kidneys were healthy and were normal in position. Part of the transverse colon was separated from its attachments, its mesocolon having been completely divided, and the omentum had been removed from all but the left one and a half inches of the stomach. The left pleurocolic fold was intact. The spleen had a wound on the lower end of its inner surface, one and a half inches long. The left half of the pancreas was absent, its cut surface presenting many ligated points. There was a smooth, encapsuled growth situated in the gastrohepatic omentum, with the bile-duct and some vessels in front of it. The neck of the gall-bladder and the transverse fissure of the liver were above it. The foramen of Winslow was behind and the new-growth seemed to be connected with the head of the pancreas below, the connexion between the two being much constricted.

"The parts were sent to the Royal College of Surgeons of England, and when they had been dissected, it was found that the mass in the lesser omentum was a new-growth inside the portal vein and widely distending it. Mr. Shattock has examined the tumours, and both are fibrosarcomatous in structure. The specimens are preserved in the museum of the college, and the accompanying illustrations (Figs. 301, 302, 303), which are reproduced from photographs taken by Mr. H. George, give a very faithful representation of their appearance."

The only circumstances in which the removal of solid tumours from the pancreas would seem to be feasible are these: (*a*) Where the tumour is pedunculated; (*b*) when it can be enucleated; (*c*) when it occupies the tail of the gland or the part of the body adjacent thereto; (*d*) when the vascular adhesions are not so numerous or so complex as to make the mechanical difficulties almost insuperable.

The question as to palliative operations in carcinoma of the head of the gland has still to be considered. It might be supposed that since many of the symptoms—jaundice and itch-

ing (sometimes absolutely maddening)—are due to the hindrance to the free outflow of bile, an operation destined to divert the current of bile would afford relief. Such operations as cholecystotomy and cholecystenterostomy have been practised on many occasions, and with almost uniformly bad results. The risk of the most trifling exploration in such cases seems to be very great; so far as can be gauged from statistics of published cases it is at least 60 to 70 per cent. The risks of either cholecystotomy or cholecystenterostomy are even greater than this. Murphy had 10 deaths in 12 operations of cholecystenterostomy, and the experience of others is equally unfavourable. Palliative operations, therefore, are to be condemned, in part because of their great risk, in part because of the lack of any benefit therefrom. The only circumstance justifying an exploration is the existence of doubt as to the exact nature of the disease. When there is a well-founded suspicion that chronic pancreatitis is present, an exploration, followed, if thought necessary, by the drainage of the gall-bladder, may be performed.

CHAPTER XLVII.

PANCREATIC CALCULUS.

THE occurrence of stone in the pancreas was first recorded by Graaf in 1667. Morgagni in 1765 and, in England, Cawley in 1788, refer to instances observed by themselves. In 1883 Johnston collected the notes of 35 recorded cases. The fullest account was given in 1886 by Giudiceandrea, and was based upon 48 recorded cases and two observed by the author.

The stones are generally white, greyish-white, or yellowish-white in colour, and rounded, ovoid, or elongated, like a date-stone. They are found in all parts of the duct of the pancreas, though much more frequently in the head; in the tail of the gland they are rarely seen.

The calculi may be branched, like coral, the trunk of the stone lying in the main duct and its offshoots in the secondary ducts. At times the canal of Wirsung is found packed with a coarse, mortar-like material, or with sand or fine, rounded pellets. The largest stone, measuring two and a half inches by half an inch, was seen by Schupmann. Calculi may be single or multiple; one of the most striking examples of the latter is in the Museum of the Royal College of Surgeons of England (specimen 2834, Curnow's case). As many as 300 stones have been found in one case. The stones are chiefly composed of phosphorus and carbon salts. One case of oxalate-of-lime stone is reported by Shattock.

TREATMENT.

The following case, recorded by me in the "Lancet," August, 1902, is the first in which a diagnosis of calculus of the pancreas has been followed by a successful operation.

I saw the patient with Dr. H. M. Robertson, of Roundhay. She was lady, aged fifty-seven, who had suffered for several

months from symptoms which briefly may be enumerated as follows:

There was steady loss of health, gradual wasting, irregular pigmentation of the skin in patches of the colour of café-au-lait (very closely resembling the pigmentation of molluscum fibrosum), persisting attacks of epigastric pain, and uneasiness of the type of hepatic colic, though less severe and unattended until very late in the history by jaundice, which was then always trivial, though unmistakable, and pain passing through from the front of the abdomen to the middle of the back. There was no rigor or any complaint of sensations of heat or cold. The stools were occasionally "frothy" and "greasy." On examination under chloroform some indefinite swelling could be felt above the umbilicus and a little to both sides of the median line, though chiefly to the right.

I considered that the evidence warranted a diagnosis of chronic pancreatitis. To explain the onset of this condition I suggested that a pancreatic calculus was present; that its transit down the canal of Wirsung had been attended by the attacks of epigastric colic; and that as it approached the ampulla an inflammatory condition had been started in the common duct, and a slight jaundice had thereby resulted. Upon this diagnosis I felt justified in basing my suggestion for operative treatment. If chronic pancreatitis were found and no cause was discoverable, the condition could be relieved by drainage of the gall-bladder; if a pancreatic calculus were found, it could be removed either from the pancreatic duct or from the ampulla of Vater, if it had travelled so far. I was bound to admit the difficulties of the case; and though I pressed the question of operation, I felt that I could give no definite undertaking as to its result.

Operation was performed on May 22, 1902. The abdomen was opened two inches to the right of the median line by an incision about seven inches in length, and the fibres of the rectus were split. On opening the abdomen the gall-bladder at once

presented; it was tense, well filled, and free from any adhesion; the cystic duct, hepatic ducts, and common duct were all thoroughly examined, the liver being rotated for that purpose. The ducts were all free from adhesion and nothing abnormal was felt. The head of the pancreas was very much enlarged and hard, the body less so, but still larger and denser than the normal. The chronic pancreatitis affected the whole gland, but chiefly the head, and in least degree the tail. The duodenum and the head of the pancreas were carefully examined, and a small lump was then felt, as it seemed, between the two. The swelling did not feel like a stone, and I expressed a suspicion that it might prove to be a growth deep in the ampulla of Vater. I therefore opened the duodenum and exposed the papilla Vateri; this was quite normal in appearance. The lump, however, was felt to be only a short distance beneath the mucous membrane. The papilla was, therefore, laid open, and the cut edges were seized with a small French vulsellum and held apart. At the bottom of the ampulla, lying in the end of the canal of Wirsung, a small object could be seen, and the knife touching it could be felt to be impinging upon soft stone. A small scoop was therefore passed into the dilated duct, pressure was made upon the head of the pancreas close to the duodenum, and the stone was lifted out.

The wound in the duodenum was stitched up with continuous sutures and the abdomen closed. The patient made a most satisfactory recovery, and is now (March, 1905) quite restored to health, being heavier and in better general condition than she has been for years.

Since this case was reported, Mayo Robson has operated upon a case of pancreatic calculi (see "Lancet," vol. i, 1904, p. 913). The patient was a woman aged fifty-seven from whom four calculi were removed: one was removed from the duct of Santorini or one of its branches by direct incision into the pancreas close to the common duct; two were removed through an incision made in the duodenum to expose the papilla Vateri, which

was laid open; one was removed by incision of the body of the gland. The wounds in the pancreas were sutured by catgut.

Other cases of removal of pancreatic stones are recorded by Pearce Gould, Dalziel, and L. W. Allen.

There are, therefore, two routes by which a stone lying in the duct of the pancreas may be reached:

(*a*) By direct incision of the gland over the stone, followed by suture of the wound.

(*b*) By opening the duodenum, exposing the papilla of Vater, incising this, and passing a scoop or a pair of fine forceps along the duct.

It is important to remember that calculi in the pancreas are often multiple, and that, therefore, the surgeon must not rest content with the removal of the first stone encountered.

(*a*) The easiest method of access to the body of the gland is to incise the gastrohepatic omentum, to pull the stomach downwards and to the left, and so to bring the pancreas into view. The sand-bag beneath the back will project the gland forwards and bring it, therefore, much nearer to the surface. The gland being exposed and the stone located, the peritoneum is carefully protected by the double layer of gauze swabs in the usual manner. This is especially necessary in operations upon the pancreas on account of the character of its secretion and the known liability of serious changes in the parts around, such as digestion and infection, to occur. The peritoneum of the posterior wall of the lesser sac is divided carefully and the pancreas is then incised directly on to the stone, any bleeding points being at once seized, and the calculus is removed. The escape of blood or secretion is very carefully prevented by free mopping with dry swabs. The incision in the gland is then carefully sutured with catgut, and the overlying peritoneum drawn into careful apposition with a fine catgut or Pagenstecher suture. Drainage should be provided in all cases.

(*b*) The removal of the stone through the duodenum is carried out in precisely the same manner as in the operation of duodenocholedochotomy.

CHAPTER XLVIII.

OPERATIONS UPON THE SPLEEN.—SPLENECTOMY.

INDICATIONS FOR THE OPERATION.

THE following are the conditions which may call for the removal of the spleen:

1. Injuries—
   (*a*) Prolapse.
   (*b*) Penetrating wounds.
   (*c*) Subcutaneous rupture.
2. Abscess.
3. Tubercular disease.
4. Cysts.
5. New-growths.
6. Malarial and other enlargements.
7. Wandering spleen.

Leukæmia was formerly included among these conditions, but it is now universally conceded that splenectomy in this disease is unjustified. The patient's life is not prolonged, nor his comfort increased thereby; while in the majority of cases life is considerably shortened.

Injuries of the spleen are by no means infrequent. In a series of 292 cases of injuries, of varying degrees of severity, of the abdominal contents, Makins found 89 cases of rupture of the solid viscera. The largest number were those of the kidney —39 per cent.; next, those of the liver—23.5 per cent.; and third, those of the spleen. As a rule, a diagnosis of injuries of the spleen cannot be made. The symptoms and the signs are not sharply differentiated from those resulting from injury to other abdominal organs. The chief signs are shock, collapse, symptoms of internal hæmorrhage, the presence of fluid within the abdominal cavity, as shewn by dulness in the flanks, a ten-

dency to vomiting, and great rigidity of the abdominal muscles, often especially localised over the upper left quadrant of the abdomen.

1. **Injuries.**—(*a*) *Prolapse.*—Prolapse of the spleen through a wound in the abdominal wall is not often met with. Laspeyres, who has made an exhaustive study of the recent literature of splenectomy ("Cent. f. d. Grenzgeb. d. Med. u. Chir.," 1904), found only three cases recorded in the last eight years. As a rule, reposition of the organ after due observance of aseptic precautions is possible and is attended by satisfactory results. Ledderhose has observed gangrene to follow the unreduced prolapse of the organ.

(*b*) *Penetrating Wounds.*—These are inflicted either as gunshot wounds or as stab wounds. Schäfer has gathered together the reports of 88 cases; of these, 71 were due to gunshot, 17 to stab, wounds.

Among the 71 cases of gunshot wounds there was only a single case in which the spleen alone suffered injury, a circumstance accounted for by the fact that the organ was grossly enlarged. The frequency with which other structures were involved is shewn in the following list:

Diaphragm	56
Left pleura	50
Stomach	32
Liver	28
Left lung	23
Left kidney	11
Pericardium	8
Heart	4
Small intestine	3
Large intestine	3
Pancreas	3
Spinal cord	3
Right pleura	2
Right kidney	2
Left adrenal	1
Aorta	1

Among the 17 cases of stab wounds, the pleura, diaphragm, and spleen were simultaneously injured in 14 cases; in 2 of

these 14 cases the left lung and the left kidney were wounded, and in 1, the transverse colon. In 2 cases the spleen only was damaged, and in the remaining case the injuries were multiple.

A gunshot or stab wound of the spleen is almost invariably fatal within a short period of time. The existence of such an injury is, therefore, a distinct and direct indication for operative treatment at the earliest possible moment. The exact method to be adopted with the spleen can be decided upon only after the organ is exposed. In Schäfer's list closure of the wound by suture was undertaken 11 times, with success in 9 cases. Removal of the spleen was thought necessary in 10 cases, of which only 3 recovered. To these cases of splenectomy Laspeyres adds 7 cases, with 3 recoveries; so that in all, 17 cases of splenectomy are recorded, with 6 recoveries.

(*c*) *Subcutaneous Rupture.*—Lewerenz has collected the records of 135 cases of subcutaneous rupture of the spleen up to 1900. Among these were 82 cases in which the spleen shewed gross pathological changes, such as malarial enlargement; in 9 cases the enlarged spleen of late pregnancy was injured.

In 104 cases the result was fatal, and in almost all it occurred within the first twenty-four hours. In 5 cases death was delayed for periods varying between two and six weeks, and was caused by secondary inflammatory processes occurring in hæmatomata, suppuration, and peritonitis, for example.

Splenectomy was carried out in 25 cases, with 13 recoveries; tamponade, in 2 cases, of which 1 recovered; and suture in 1 case, which ended fatally. Laspeyres has found, in the statistics of the last eight years, 58 cases of splenectomy or subcutaneous rupture recorded; of these, 39 recovered, equivalent to a percentage of 67.2.

As a general rule, removal of the spleen is the surest means of saving life, and should be practised, therefore, as the routine method of treatment. There are a few cases on record where postmortem examination has shewn that this could not have been carried out, owing to the numerous and intricate peri-

toneal adhesions which surrounded the organ. In such circumstances packing with gauze, soaked, if need be, in adrenalin solution, is the only procedure that is feasible.

2. **Abscesses in connexion with the spleen** are rare, and are generally secondary, being due to the breaking-down in an infarct which was caused by an infected embolus. Suppuration may also occur in a hæmatoma due to a minute tear in the substance of the spleen.

Bessel Hagen found 7 cases of splenic abscess treated by operation recorded up to 1900; 3 cases have since been recorded by Murphy, Karewski, and Ebehart. Suppuration in the spleen may lead to the formation of one abscess or of many abscesses. A primary infection within the abdomen may be recognised, as, for example, appendicitis (one case), pyosalpinx (one case). Typhoid fever is occasionally the cause; 12 cases observed during life or found postmortem are recorded by Esau. When pus is found around the spleen, a diagnosis of subphrenic abscess will probably have been made. When the abscess is opened, the entire spleen may be seen swimming in the abscess cavity, or detached portions of it may be evacuated as sloughs. In one very remarkable case recorded by Georgescu Mangiurea, the spleen was discharged as a slough through an opening at the umbilicus. The protrusion at first was small, but rapidly enlarged, and an acute inflammatory process set in.

Splenotomy may be practised in one or two stages, though it is rarely permissible or feasible. Splenectomy is the operation of choice.

3. **Tubercular Disease.**—Very few cases of tubercular disease of the spleen treated by operation have been recorded. Bessel Hagen found one unsuccessful case of splenectomy recorded before 1890, and two successful cases between 1891 and 1900. Since this last date three further cases have been recorded by Carle, Grillo, and Lannelongue. In Carle's case the patient had borne two children after the operation and remained quite well. Grillo's patient remained well fifteen months after operation.

In the great majority of cases tubercular deposits in the spleen are found only as a part of a widely spread infection. The peritoneum and other organs in the abdomen are also involved; and the affection of the spleen is clinically inconspicuous and pathologically unimportant. In the cases in which operation has been performed the tubercular deposits seem to have been of a markedly chronic character, and in some the spleen has been unduly mobile.

4. **Cysts.**—Following is the classification of splenic cysts:

(*a*) Unilocular and multilocular cysts not of parasitic origin; serous cysts; blood cysts; lymph cysts.

(*b*) Hydatid cysts.

(*c*) Dermoid cysts.

The first case of cyst of the spleen is recorded by Andral in 1829; the cyst was found postmortem. The first extirpation of the spleen on account of a cyst was performed, with a successful result, by Péan in 1867. In 1891 Terrier performed partial splenectomy successfully, and in 1896 Glück treated a blood cyst by incision and drainage.

(*a*) *Serous Cysts* (*Serosanguineous Cysts*; *Lymph Cysts*).—The contents of a serous cyst may be clear serous fluid, fluid stained with blood, the remains of a hæmatoma, or seropurulent. Bessel Hagen records 7 cases of cyst of the spleen treated up to the year 1900; all the patients recovered. Since 1900 there have been, according to Laspeyres, 4 cases recorded, making a total of 11 cases, all successful.

(*b*) *Hydatid cysts* are the most common of all forms of cyst of the spleen. As a general rule, hydatid disease is not confined to this organ, but affects also, and generally in wide-spread manner, other parts within the abdomen, more especially the liver. According to Litten, hydatid cysts of the spleen are always unilocular and are prone to undergo calcification. The frequency of the affection is shewn in the statistics collected by Trinkler, who, in 2117 cases of hydatid disease, found echinococcus of the spleen in 68.

The methods of treatment which have been adopted are two—*incision and drainage*, the operation being performed in one or in two stages, and *splenectomy*. The latter is the operation of choice, and is to be performed in all cases when it is possible. In some of the recorded examples the adhesions of the spleen have been so numerous and so dense that removal of the organ has been utterly impossible. Snegireff, in attempting to separate a number of adhesions preparatory to the excision of a cyst of the spleen, tore the spleen deeply; free bleeding resulted and splenectomy had to be performed. The mortality for the operation of splenectomy, according to Bessel Hagen, is 10 per cent.; according to Tédénat, 14.2 per cent. Since 1894, 14 cases have been recorded, and all have been successful.

Resection of the spleen has been successfully performed by Terrier, Gussenbauer, and Bardenheuer.

5. **Neoplasms.**—The number of cases of new-growths in the spleen recorded in the literature is very small.

(*a*) *Sarcoma.*—An admirable paper by Jepson and Albert on "Primary Sarcoma of the Spleen" appears in the "Annals of Surgery," vol. xl, page 80.

The first cases recorded are two by Weichselbaum in 1881. The total number collected by Jepson and Albert is 32, but the exact nature of a certain number of these cases is open to question, the microscopic report not being of sufficient worth to satisfy modern requirements. Of these 32 cases, there were 12 submitted to operation, 11 to splenectomy, and 1, by Heinricius, to enucleation of the growth. Of the 11 splenectomies, 3 died as the result of the operation. Of the 8 who survived the operation, 3 patients have since died of recurrence, and of 1 patient the information is scanty. Two of the 4 remaining patients lived six and a half years and four years; and 2, including Jepson's case, were recorded too recently for any time-estimate to be of value.

A table of all the cases with the details available is given by Jepson and Albert.

(*b*) *Cavernous Angioma.*—Three cases of cavernous angioma have been treated surgically; in 2 cases splenectomy was performed; in both cases the patients died; in 1 case a resection of the spleen was undertaken by Snegireff successfully.

(*c*) Other forms of splenic tumour, fibroma, for example, and endothelioma, myxoma, and lipoma, of which single examples are recorded, are so unusual that specific mention of them is not necessary.

6. **Malarial and Other Enlargements of the Spleen.**—The removal of the "ague-cake," the greatly enlarged spleen found in malarial fever, has been carried out in a large number of cases with fair success. The reasons which call for the removal of the spleen are its large size, its great mobility, and its consequent tendency to rupture. Spontaneous rupture is not infrequent in the tropics, and laceration from injury of the enlarged organ often occurs.

Bessel Hagen records 24 cases up to 1890 with 15 deaths; between 1891 and 1900 there were 64 cases with 15 deaths. In a review of the recent cases Laspeyres, in 1904, assessed the mortality in 69 cases at 8.7 per cent. Removal of the spleen in cases of malarial enlargement, according to Schwarz, is needed only when there is undue mobility of the organ. Any beneficial effect upon the course of the malaria is not to be expected, though in some cases it has undoubtedly been observed. He records 10 cases in his own practice, with one death, on the fourteenth day, from peritonitis. In all the spleen was movable, and in 6 the pedicle was twisted.

Simple hypertrophy of the spleen, of unknown origin, has been operated upon 16 times, with 3 deaths. The nature and the causes of this condition of simple hypertrophy are not well understood, nor can it be said that the circumstances calling for operation are capable of being stated categorically. For the most part, the operation has been undertaken because the spleen was both bulky and mobile, and by its sheer weight or

undue freedom of movement, or both, had become a source of the greatest inconvenience.

Banti's Disease. Of the various conditions in which the spleen may be enlarged, especial mention of the disease which is known as "splenic anæmia," or Banti's disease, is necessary.

The disease occurs in young adults, as a rule; it begins insidiously, and at first progresses slowly. It may be that the patient first realises that things are not well with him by noticing the presence of a swelling on the left side of the abdomen. Soon after this hæmorrhages occur, hæmatemesis, epistaxis, melæna,—slight or so severe as to be almost fatal. There is anæmia of a secondary type, though the blood-count is liable to variations in proportion to the amount and the frequency of the hæmorrhages. Senator states that the blood examination reveals a fairly uniform condition of things.

1. There is a diminution in the red blood-cells, the averages being about 3,500,000.

2. There is a low percentage of hæmoglobin.

3. There is a diminution in the number of white corpuscles.

There is sometimes a marked pigmentation of the skin, which has been observed, in one case at least, to disappear after the removal of the spleen.

In a later stage of the disease ascites appears, preceded or not by cirrhosis of the liver. It is this association of enlarged spleen, ascites, and cirrhosis of the liver to which Banti has drawn especial attention. He pointed out that in cases of this association the enlargement of the spleen, sometimes, at least, was the precursor of the other two conditions, and that it was very possibly the cause of their onset. The splenic enlargement he considered attributable to a toxæmia, the poison being derived from the intestinal canal. Banti described three stages in the disease. In the first stage anæmia and splenic enlargement are found, the former being secondary to the latter. In the second stage there is commencing cirrhosis of the liver with persistent diminution in the quantity of urine and an increase

in the bile-pigment and urates. In the third and most characteristic stage there is ascites, which is insidious in origin and painless.

It is probable that more conditions than one are classed together under the term "Banti's disease." The whole subject of idiopathic splenic enlargements is in need of elucidation.

Osler's definition of splenic anæmia is as follows: "A chronic affection, probably an intoxication of unknown origin, characterised by a progressive enlargement of the spleen, which cannot be correlated with any known cause, such as malaria, leukæmia, syphilis, cirrhosis of the liver, etc. (primary splenomegaly); anæmia of a secondary type (leucopænia), a marked tendency to hæmorrhage, particularly from the stomach; and in many cases a terminal stage, with cirrhosis of the liver, jaundice, and ascites (Banti's disease).

The course of the disease in some cases is slow, in others rapid. The patient becomes steadily worse, especially after ascites and jaundice have set in, and death may come by gradual exhaustion or suddenly from hæmorrhage.

The surgical interest in the subject centres around the possibility of giving the patient relief by splenectomy. If the splenic enlargement is the primary condition, the anæmia, cirrhosis, and ascites being secondary thereto, it is not unreasonable to hope that the removal of the offending organ may cut short the progress of the disease. The difficulty in arriving at an exact diagnosis is, however, not inconsiderable, and the first stage in which much benefit may result from splenectomy may unavoidably be allowed to slip by.

In operating upon a case in the late stage, when ascites was present, Tansini performed splenectomy and epiplopexy. Four weeks after the operation the abdomen had to be tapped on account of the reaccumulation of fluid; after this the patient was perfectly well several months later when the report was published. Rafferty ("Jour. Amer. Med. Assoc.," June 16, 1900) records a somewhat similar case. In the published records of

operations for Banti's disease it is perfectly clear that many other conditions have really been present, such as simple hypertrophy of the spleen, leukæmia, etc. An accurate estimate of the mortality is, therefore, impossible at present.

7. **Wandering Spleen.**—Ectopy of the spleen, or a wandering spleen, in the majority of cases, is associated with, and is, indeed, a part of, that condition of general prolapse of all the viscera which is known as enteroptosis or Glénard's disease. In some few instances the mobility is solely due to an increased weight in the organ, the result of hypertrophy or new-growth. On the other hand, Steinbruck and Mainzer have both recorded cases in which it seems probable that the dislocation of the spleen, by causing persistent congestion of the organ, had been responsible for growth in one case and hypertrophy in the other. The condition is found far more frequently in women than in men.

Bessel Hagen records, between 1891 and 1900, 15 cases of wandering spleen with malarial enlargement treated by splenectomy, with 1 death; and 28 cases of idiopathic hypertrophy of the wandering spleen treated by splenectomy, with 2 deaths.

One of the chief dangers in wandering spleen is torsion of the pedicle. Schwarz records 10 cases of malarial enlargement of the spleen operated upon by himself; in 6 there was torsion of the pedicle. Subbotic, in 6 cases, found the pedicle twisted in 4. The pedicle may be of great length and tenuity, forming, as it were, merely a ribbon of attachment.

The twisting of the pedicle of the spleen may be a matter of long standing, causing only engorgement of the organ and a gradual increase in size; in some such cases there has been pressure upon the intestines, chiefly upon the colon, of sufficient severity to cause symptoms of intestinal obstruction. On the other hand, the symptoms which result from the rotation of the organ may be acute in character, simulating an attack of acute peritonitis or of acute obstruction. A tumour, taken to be a subphrenic abscess or a perigastric abscess, may be felt. There are several cases recorded in which operations have been

undertaken for this acute condition, and in some, large infarcts have been found in the spleen or large thrombi in the vessels of the pedicle.

The extent to which the pedicle is twisted varies much; in Subbotic's 4 cases there was a twist of 180 degrees in 2 cases, of 360 degrees in 1 case, and of twice 360 degrees in 1 case.

In the great majority of cases splenectomy must be performed, especially when thrombosis of the vessels of the pedicle, infarcts in the spleen, gangrene of the organ, or peritonitis upon and around it, are present.

In some cases, however, splenopexy has been performed with complete success, the twisting of the pedicle being undone and the organ fixed in one of the recognised methods. Treves, in his work, "A Manual of Operative Surgery," records two cases of this kind upon which he had operated successfully; in one, infarcts were present.

When the organ is enlarged, it should in all cases be removed, for attempts to fix it will almost certainly be unsuccessful.

Splenectomy has been performed for other conditions than those included in the above list, such as amyloid disease and leukæmia. Operation in these circumstances is, however, unjustifiable. The mortality is high and no real benefit results from the removal of the organ.

If we place together Bessel Hagen's statistics and Bayer's we find that from 1891 to 1904 there were recorded 254 cases of splenectomy, with 200 recoveries and 54 deaths. The several percentage mortalities were as follows:

Leukæmic hypertrophy	8 cases	2	recoveries	6 deaths
Splenic pseudoleukæmia	1 case	1	recovery	
Ruptures	43 cases	28	recoveries	15 "
Abscess	4 "	all	recovered	
Tuberculosis	3 "	all	"	
Blood cyst	4 "	all	"	
Hydatid cyst	13 "	12	"	
Sarcoma	5 "	4	"	1 died
Simple new-growths	2 "	1	"	1 "
Rotation of pedicle	15 "	10	"	5 "

Malarial enlargement	89	cases	71	recovered	18 died
Hypertrophy of wandering spleen	29	"	27	"	2 "
Banti's disease	17	"	14	"	3 "
Idiopathic hypertrophy	21	"	19	"	2 "

THE AFTER-RESULTS OF SPLENECTOMY.

The after-results of splenectomy, so far as the blood is concerned, are: a diminution in the amount of hæmoglobin; a reduction in the number of the red corpuscles; and an increase in the total number of white corpuscles. These changes attain their maximum in about a fortnight, and there is then a gradual return to the normal, which is reached in about four months. Pyrexia has been observed in some cases, but in them has perhaps been due to slight septic infection. Mental disturbance is occasionally noticed, and in many cases a general enlargement of the lymphatic glands. Lacrettic has remarked upon the fact that pain in the bones may be felt after operation, and attributes it to increased medullary activity. In animals it is frequently found that after splenectomy the bone-marrow becomes reddened and much denser. Other changes less frequently recorded are loss of weight, great weakness, thirst, polyuria, rapidity of pulse, enlargement of the thyroid gland, and abdominal pain and tenderness. Tizzoni has pointed out that all the effects which follow removal of the spleen are less noticeable in children, owing to the fact that their compensatory organs act more rapidly and more completely. The removal of a spleen disorganised by long-standing disease is also less likely to be followed by any symptoms, owing to the fact that the compensation has been progressing quietly for many weeks or months before operation. It has been suggested—and experimental work to some extent corroborates this—that an animal deprived of its spleen becomes more liable to infection by any septic organisms. In a case recorded by Harrison ("Brit. Med. Journ.," February 10, 1906) we found that digestion leucocytosis was absent after splenectomy even when a blood examination was made as long as six months after operation.

SPLENECTOMY: DETAILS OF THE OPERATION.

The removal of the spleen may be an operation of the greatest simplicity or of insuperable difficulty. Everything depends upon the presence or absence of adhesions, which may bind the organ inseparably to the parts around. In several cases it is recorded that an attempt at the removal of the gland had to be abandoned because it was found impossible to dissever the adhesions, or because laceration of the spleen in an attempt to do so seemed unavoidable.

The incision will fall upon the abdominal wall at any part that seems most suitable. When the spleen is large and very mobile, a median incision is preferable. In the majority of the cases of all kinds it seems to have been the chosen incision for the reason that it gave easier access to the pedicle from the inner side. In cases of ruptured spleen the median incision will probably have been made, the operation having begun as an exploratory one; this is an advantage because it allows of a clear examination of other viscera within the abdomen. An incision through the outer border of the rectus is sometimes used, with or without lateral extensions subsequently made to give additional room. The incision, wherever placed, should be of adequate length to allow a perfectly clear view of the operation field, and to render it unnecessary to have any force applied to the spleen or its adhesions to bring them into sight. Vanverts, and more recently Auvray, has suggested an oblique incision along the costal margin with resection of the costal cartilages of the eighth, ninth, and tenth ribs. They emphasise the facts that a better exposure is thus secured and that an easier and surer manipulation of the pedicle is possible. The incision is made on the left side, in the same manner as that on the right side is made, for the purpose of exposing the upper surface of the liver.

The first step in the operation is the isolation of the spleen, a step which is easy or difficult according as adhesions are few

or many. In separating adhesions the utmost gentleness and patience must be exercised; undue haste or carelessness will court disaster. The thinness of the capsule of the spleen, and of the veins in its pedicle, and the softness and friability of the substance of the gland, must be remembered. The adhesions must be divided everywhere between ligatures. More than one case is recorded in which death has resulted from continued oozing from the raw surface left by the stripping of adhesions. When the exposed surface of the spleen is cleared, the hand is passed upwards between the organ and the diaphragm. In some cases, as Collins Warren remarks ("Annals of Surgery," vol. xxxiii, p. 524), the spleen can readily be pulled down by the hand thus introduced and be turned completely over. In this way the vessels of the hilum are immediately made superficial and can be readily seized and controlled.

The omentum is sometimes very adherent to a splenic tumour, and the vessels in it are then greatly engorged. A division of the omentum, a little distance away from the spleen, by a series of interlocking ligatures, is then necessary. Adhesions to the stomach must be dealt with respectfully, and wounding of the vasa brevia or stripping of the peritoneum from the stomach is to be expressly avoided.

The spleen, when freed from all adhesions, is brought slowly into the wound. In handling it a layer or two of gauze placed beneath the fingers will give a surer hold. In delivering the spleen from the abdominal cavity any dragging upon its pedicle must be prevented. The vessels which, with their peritoneal investment, constitute the pedicle are numerous, and the veins are possessed of extremely thin walls. Laceration of the veins has occurred in two cases recorded as the result of forcible withdrawal of the spleen; and in one, death occurred from hæmorrhage within a few minutes.

The ligation and division of the pedicle are now performed, and this is the step of chiefest importance in the operation. The pedicle consists of the vessels going to the hilum of the spleen,

together with their peritoneal investment. The two peritoneal folds concerned in the pedicle are the gastrosplenic omentum and the lieno-renal ligament. "The gastrosplenic omentum consists of two layers of peritoneum which pass from the front of the hilum of the spleen forwards and outwards to the posterior surface of the stomach, near its left border. If the outer of these layers be traced over the spleen, it will be found to cover the gastric surface to the left of the hilum, the phrenic surface, and the posterior part of the renal surface. It is then reflected on to the kidney, forming the posterior layer of the lieno-renal ligament. The inner layer of the gastrosplenic omentum is derived from the lesser sac, and is continued into the anterior layer of the lieno-renal ligament. Below, the two layers of the gastrosplenic omentum are continuous with the gastrocolic omentum. The splenic vessels pass to the spleen between the layers of the lieno-renal ligament (Quain)." Unless the spleen is very large, and the vessels therefore of unusual size, it is best to transfix the pedicle carefully between two vessels with a clip, then to draw through, in the bite of the clip, a long double ligature. The two halves of the ligature are made to interlock, and each half secures its own side of the pedicle. A separate ligature embracing the whole thickness of the pedicle is then made secure, and the pedicle divided distal to the ligatures and the spleen removed.

If the vessels are large, a separate ligature of each one in two places, with division of the vessel between, from below upwards, may be necessary. The vessels may be isolated by blunt separation carried out by the fingers covered with a layer of gauze.

A simple method of securing the vessels is the following: A large stomach-clamp is applied to the pedicle as close to the spleen as possible. Then, about 1½ inches away, a series of clips (the long clips of my own pattern are the best) is applied from below upwards. As each clip is applied the pedicle is cut through between it and the large clamp. When all the clips

—three, four, five, or even more in number—are applied, a long ligature is taken, tied around the portion of the pedicle included in the uppermost clip, the clip is loosened slowly and removed, a double knot tied, then the next clip is raised, and the same ligature, without division, is passed around it, tied, the clip removed, and so on, as before. Every part of the pedicle is thus secured in one ligature, which is knotted in between each clip. For the ligature, stout catgut or Pagenstecher thread may be used. The ligature should always be thick, otherwise the flimsy vessel-wall may be cut through. In some cases the tail of the pancreas has accidentally or deliberately been included in the ligature surrounding the pedicle, in order to ensure a firmer hold. Esmarch advises that this should be done if there is any doubt as to the security of the ligature.

After the spleen has been removed, a careful examination of the cavity left is made, and any slightly oozing point is secured. The under surface of the diaphragm, especially, must be examined, and any bleeding point thereon secured by a stitch. When the surgeon is satisfied that all parts are dry, the abdominal incision is closed in the usual manner.

The operation is one which may call forth all the resources of the surgeon. The chief difficulties are those concerned with the adhesions and with the ligation of the pedicle. In a few cases, as in one recorded by Spanton, a dragging of the pedicle may cause sudden symptoms of shock or collapse, owing to the irritation of the nerves of the solar plexus.

SPLENOTOMY.

Incision of the spleen may be called for in cases of abscess or cyst. Tédenat and Fontoynant recorded cases of abscess of the spleen which were successfully treated by incision and drainage. Giuliano, in reporting a case of hæmorrhagic cyst of the spleen, gives brief abstracts of 15 other cases treated by incision and drainage or aspiration.

The abdomen may be opened through the linea semilunaris

in the case of cysts or of abscesses not pointing; or through the linea semilunaris. In some cases a transpleural operation with resection of one or more ribs may be necessary. The details of the operation need not be particularised.

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CHAPTER XLIX.

SPLENOPEXY.

THE operation of splenopexy, the fixing of a wandering spleen, is certainly preferable to splenectomy in a small number of cases. Where the spleen is enlarged or the pedicle so twisted that thrombosis of the vessels therein has resulted, or where any disease of the spleen exists, removal of the organ is necessary. In those cases alone where a perfectly healthy organ is unduly mobile is splenopexy to be performed.

The operation was first mentioned in surgical literature by Rydygier, in 1895, in a paper read at the German Surgical Congress ("Cent. f. Chir.," 1895); subsequent to this publication Tuffier reported, at the Surgical Congress in Paris in 1895, that he had in 1882 performed the operation. The case was one in which he was preparing to fix a movable left kidney by suture; a movable tumour in front of the kidney was found, the peritoneum opened, and a wandering spleen discovered. The organ was fixed by three sutures of catgut. Kouwer also reported, in 1895, that he had operated upon two cases successfully in 1891. Priority of publication belongs, however, as I have said, to Rydygier.

The following are the methods which have been adopted for fixing the spleen.

1. **Tuffier's Method.**—Suture of the spleen to the diaphragm or abdominal wall. The stitches may be of silk or catgut, and pass into the substance of the organ. Tuffier does not mention whether any hæmorrhage occurred from the spleen in his case. This operation has been performed by Greiffenhagen, who passed two stout silk sutures through the abdominal wall and through the parenchyma of the spleen. Alarming hæmorrhage followed, which was with difficulty controlled.

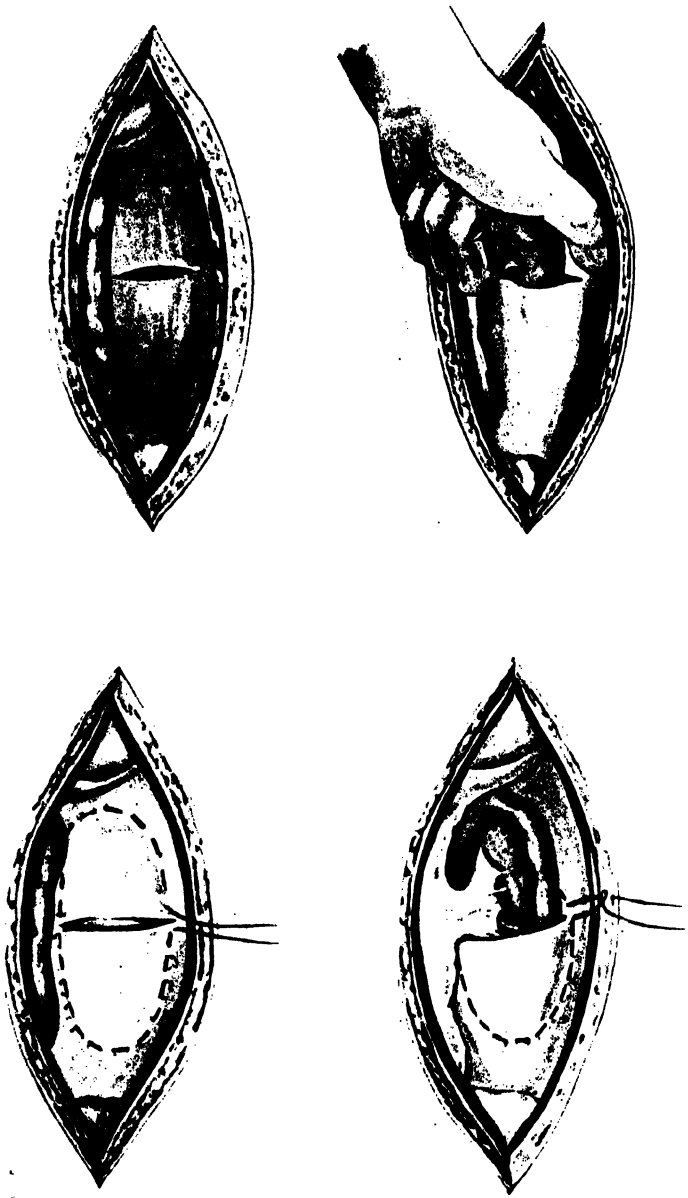


Fig. 304.—Splenopexy (Rydygier's method). Incision in the peritoneum on the under surface of the diaphragm, and the formation of pockets above and below by the stripping up of the peritoneum. The upper pocket is very difficult to fashion, owing to the strong adhesion of the peritoneum there to the diaphragm.

This method is not one to be commended. The risk of hæmorrhage is serious. Other and safer methods have now displaced it.

2. **Kouwer's Method.**—Kouwer, in both his cases, fixed the spleen by tamponade, thus causing the formation of a large number of adhesions. The consolidation of the adhesions secured the fixity of the spleen.

3. **Rydygier's Method.**—The abdomen is opened in the middle line or through the linea semilunaris. The diaphragm is exposed, and a transverse incision between the ninth and tenth ribs is made. The peritoneum above and below this incision is raised up by the finger until a pocket on each side is formed. To do this below is easy, but on the upper side the adhesion to the diaphragm is so close that the peritoneum tears away. A continuous suture (or a series of interrupted sutures) is now applied around the upper and lower margins of the pocket, so as to limit the cavity formed by the raising up of the peritoneum. The spleen is then placed in the pocket formed for it.

4. **Bardenheuer's Method.**—The patient lies on the right side, as for an operation upon the left kidney. A longitudinal incision is made in the axillary line, reaching from the tenth rib to the iliac crest. At the upper end of this a transverse incision is added to give additional room. The soft parts are divided down to the peritoneum, which is stripped up over an area rather larger than the area of the spleen. The peritoneum is then incised, the opening being made of as small a size as will allow the passage of the spleen through it. The spleen is sought and found and drawn through the opening in the peritoneum. The size of the opening is then lessened by a few points of suture, and the wound in the parietes closed. The spleen by this operation is brought to lie altogether outside the peritoneum.

5. **Basil Hall's Method.**—My friend, Mr. Basil Hall, records ("Annals of Surgery," April, 1903) a case of wandering spleen which he treated by a novel and ingenious method. He gives the following description:

"On November 22, 1901, ether was administered, and the abdomen opened by an incision four inches long at the outer border of the left rectus abdominis. The lower pole of the spleen was exposed by this incision, and the whole organ was then delivered through it without much difficulty. It was seven and a half inches long and three and a half inches wide at its

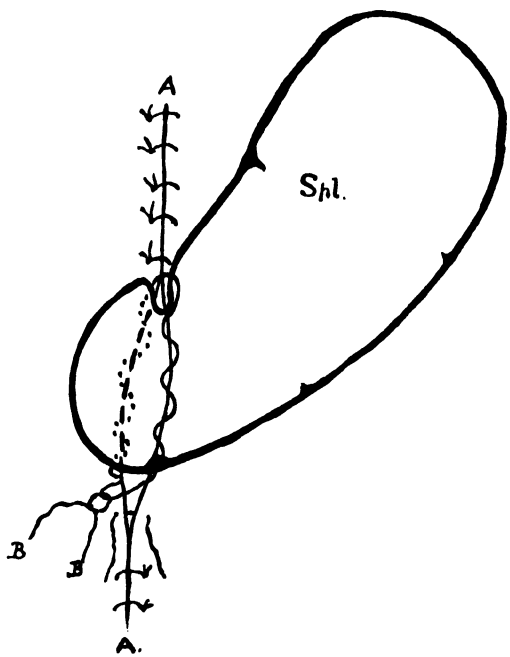


Fig. 305.—*Spl*, Spleen; *AA*, incision in abdominal aponeurosis closed by sutures, except in the center where the lower pole of the spleen projects through it; *BB*, purse-string suture carried around edges of unclosed portion of the incision. On tying this suture the aponeurotic edges close around the spleen like a waistband at the site of the splenic notch. Only one aponeurosis is here represented for the sake of simplicity. (From a drawing kindly supplied me by Mr. Basil Hall.)

centre. Except for its size, it was, to all appearances, a normal spleen. At this stage it was evident that splenectomy could be easily accomplished. The pedicle was so long that the delivery through the incision had scarcely tightened it, and the arrangement of the vessels was such as to allow of easy separate ligation. While considering the advisability of removal, however, it was noticed that the notch on the anterior border was only two to three inches from the lower extremity of the spleen,

and the depth of the notch was such that the lower pole of the spleen was only connected to the rest of the organ by a comparatively narrow isthmus. This arrangement at once suggested an easy means of fixing the organ. The main body of the spleen was, therefore, replaced in the abdomen, after rendering the parietal peritoneum raw in the splenic fossa in order to excite adhesions. Then, while the lower pole was held in the wound, the edges of the peritoneum were drawn tight by a purse-string suture until they closely gripped the narrow isthmus in the notch. The abdominal aponeurosis was next sutured in a similar manner until it grasped the isthmus in the notch sufficiently tightly to produce marked congestion of the now isolated lower pole. The left rectus muscle was next drawn outwards somewhat, so as to overlap the projecting pole of the spleen as much as possible, and the skin incision sutured. After closing the skin incision a prominent lump the size of half an orange remained."

Mr. Basil Hall tells me that the patient when last heard of (November, 1905) was quite well. Her medical attendant said that at that time "there was no sign of giving way, and the case was a surgical success."

RESULTS OF SPLENOPEXY.

The results of this operation in the cases recorded are good, though the after-history in some has not been given. Nothing is known of the after-history in Tuffier's case, in Plücker's, or in Geordano's. Kouwer's first case was well four years after operation; the spleen was in good position and securely fixed. In his second case the gauze packing had to be removed in forty-eight hours as symptoms of intestinal obstruction were appearing; in this the spleen had dropped a little, but its mobility was considerably lessened by the operation. Rydygier's patient was seen fourteen months after the operation and the conditions were perfectly satisfactory. Grieffenhagen's patient was seen seven months after operation; the spleen was in good position and was securely fixed. Hall's patient was entirely relieved of her symptoms and could undertake her house-

hold duties or any active exertion. The spleen had shrunk, but the diminution in size was not very great; it could not be displaced by palpation or any change of posture.

There does not seem to have been any mortality from the operation. In a limited number of cases, therefore, the operation is one to be preferred to splenectomy.

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